Great Brit

TWENTY-FIFTH ANNUAL REPORT

OF THE

LOCAL GOVERNMENT BOARD,

1895–96.

SUPPLEMENT

CONTAINING THE

REPORT OF THE MEDICAL OFFICER

For 1895–96.

Presented to both Houses of Parliament by Command of Her Majesty.

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PUBLIC HEALTH.

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CONTENTS.

APPENDIX A.—*cont.*

APPENDIX B.:

APPENDIX C.:

REPORT.

TO THE RIGHT HONOURABLE HENRY CHAPLIN, M.P., PRESIDENT OF THE LOCAL GOVERNMENT BOARD.

SIR,

I HAVE the honour herewith to submit to you, for presentation to Parliament, my report on the proceedings of your Medical Department for the year 1895–96. I have already laid before you a separate report on "Oyster Culture in Relation to Disease," which was undertaken during the period to which this document relates.*

Since the issue of my last annual report the Department has suffered the loss, by death, of the services of their Medical Inspector, Thomas William Thompson, D.P.H. Mr. Thompson, formerly surgeon in the 1st Life Guards and Medical Officer of Health to the Hertfordshire and Middlesex combined Sanitary Districts, was only appointed a Medical Inspector in 1890, but, during the comparatively brief period in which he served the Board, he gave evidence of the possession of great scientific and literary abilities, as also of personal characteristics which won for him, in a peculiar manner, the high esteem and regard of all with whom he came into official contact. His premature and unexpected death whilst actually engaged in the work of the Department is deeply to be deplored, on public as well as on private grounds. The vacancy thus created was filled on March 13th, 1896, by your appointing to the Permanent Medical Staff Samuel Walton Wheaton, M.D., who, as a Temporary Inspector, had for three years given valuable services to the Board. You at the same time appointed Frederick St. George Mivart, M.D., to the vacant post of Temporary Medical Inspector.

I.—Administrative Relations of the Medical Department.

1. VACCINATION AND PUBLIC VACCINATION.

I submit, in Appendix A., No. 1, a digest of the returns of the Vaccination Officers for the year 1893.

The returns deal with 914,557 births registered in England and Wales during the year 1893, and of these, 102,442, or 11·2 per cent. of the whole, were registered as having died

* Supplement by the Medical Officer to the 24th Annual Report of the Local Government Board, on "Oyster Culture in Relation to Disease" [C.—8214], 1896.

MEDICAL OFFICER'S REPORT.

unvaccinated. Of the 812,115 remaining, 661,513, or 81·5 per cent., had been certified as successfully vaccinated; in 13,845 instances vaccination had been postponed by medical certificate; 39 children had contracted small-pox before they had been vaccinated; 3,394 had been registered as "insusceptible of successful vaccination"; leaving 133,324, or 16·4 per cent., who, by reason of change of address, or for some other reason, had not been certified to have been vaccinated. Including with these latter cases those whose vaccination had only been postponed, the children who remained unaccounted for as regards vaccination at the date of the returns formed 18·2 per cent. of the total births registered in the metropolis, and 15·7 per cent. for the rest of England and Wales. The marked, and almost continuous increase in the amount of default, which has been in progress during the past seven years, received a slight check in the metropolis in respect of 1893, but in the provinces it underwent still further augmentation. With regard to the very large number of children who were certified to be "insusceptible," it appears that whilst the per-centage of such cases to births was 0·34 in the provinces, it reached 0·53, or nearly two-thirds more, in the metropolis. But from returns received from the Board's own vaccinators, covering a period of some 15 years, and having concern with no less than 95,677 consecutive primary vaccinations, it has been shown that no single case of "insusceptibility" has been met with. Nor does the experience of these officers stand alone; the same result has followed on the vaccination of many thousands of infants in the hands of other public vaccinators. True "insusceptibility" to vaccination must be rare in the extreme.

INSPECTION OF PUBLIC VACCINATION.

The number of Unions inspected for the purposes of public vaccination during 1895 was 302; these Unions included 1,401 vaccination districts, and in 980 cases the work of the public vaccinators was such that they were recommended for special award, as provided for under the Vaccination Act of 1867. (Appendix A., No. 2.)

The following changes have taken place in the staff attached to the Educational Vaccination Stations. On the 18th of April 1895, John Wyllie Nicol, M.B., was appointed to be a teacher in vaccination for the Glasgow, West, District, in the place of William MacLennan, M.B., who had resigned; on the 31st of August 1895, Albert Ernest Cope, M.D., succeeded the late Edward Lowe Webb, M.R.C.S., in the same capacity, for the Pimlico District, London; and on the 21st March 1896, the Board, having authorised the establishment of a new teaching station at Cardiff, in connexion with the Medical School attached to the University College of South Wales and Monmouthshire, approved of the appointment as teacher and examiner of John Llewellyn Treharne, M.R.C.S.

NATIONAL VACCINE ESTABLISHMENT.

In response to 3,400 applications to the National Vaccine Establishment for humanised vaccine lymph, 6,166 charged capillary tubes and 50 charged ivory points were sent out

during 1895; and during the same period 11,903 ivory points and 58 capillary tubes charged with calf-lymph were sent out in response to 1,847 applications for lymph taken direct from the calf. (Appendix A., No. 3.)

MEDICAL OFFICER'S REPORT.

The operations carried out at the Animal Vaccine Station are separately reported on in Appendix A., No. 4, by the director, Dr. R. Cory. The vaccination of the calves for the purposes of the station was, as heretofore, more successful when the operation was performed direct from the calf, than when stored calf-lymph was used. In the former case the success was at the rate of 95·5 per cent. of the insertions made; in the latter it was only 65·3 per cent. During the year reported on, 6,802 persons were primarily vaccinated at the Animal Vaccine Station, and of these, 6,736 returned for inspection. In 17 cases vaccination proved unsuccessful on the first trial; but in no instance is a second trial known to have failed. In one case fatal erysipelas occurred subsequent to the vaccination. The death took place between five and six weeks after the date of the vaccination, and the infant in question was not brought to the station after the commencement of the erysipelas.

REPORT OF THE ROYAL COMMISSION ON VACCINATION.

The Final Report of the Royal Commission on Vaccination, which was appointed on May 29th, 1889, was received by the Board in October 1896; but a large amount of the evidence on which it is based still remains to be issued

2. OTHER ADMINISTRATIVE BUSINESS OF THE MEDICAL DEPARTMENT.

CONFERENCES AND LOCAL INQUIRIES.

The current work of the Medical Department has, as in previous years, taken account of a variety of subjects, and has included numerous conferences at office on matters relating to the adoption of byelaws, and to the preparation of plans for isolation hospitals by one and another local health authority. Sanitary authorities are coming more and more to see advantage from a preliminary discussion of the debatable points arising out of proposals in which loans are involved, or in which the adaptability of the Board's Model Byelaws to the needs of particular localities raises questions of divergence from customary lines. Cases of the latter sort have also at times called for local inspection by the medical staff; and during 1895 Dr. Parsons, in conjunction with the Board's architect, visited Godalming and Morpeth in this connexion. In the matter of proposals relative to hospital provision, extensions, sites, &c., local inquiry was held by Medical Inspectors in the following cases, namely:—Barry and Cadoxton, Battle (Rural), River Blyth (Port), Bradford (Yorks), Brighton, Bromsgrove, Droitwich, and Redditch (appeal by the Droitwich Town Council against an order of the County Council for Worcestershire under the Isolation Hospitals Act of 1893), Burnley (Joint), Cardiff and Barry (Ports), Chadderton, Crompton and Royton (Joint), Christchurch (Hants, Rural), Colne, Cosford (Rural), Crediton, Crewe, Croydon (Rural), Deal

and Walmer (Joint), Eastbourne (Rural), Epsom (Joint), Felling, Hastings, Hinckley (Joint), Ilfracombe, Kettering (Rural), Leigh, Marlborough (Rural), Penrith, Richmond (Surrey, Joint), Rotherham and Wath (Joint), Stockton-on-Tees, Sunderland (Rural), River Tees (Port), Thornhill, West Derby and Wavertree (Joint), West Ham, Wetherby (Rural), and Whitchurch (Hants, Rural) sanitary districts. The provision of a mortuary at Garston, and of a disinfector at Rotherhithe were also made matter of local inquiry.

In the districts of Auckland (Rural), Holywell (Rural), Knaresborough, Mottram, and Winslow (Rural), inquiries were instituted with a view of determining whether Orders should be issued in respect of the removal of excrement and refuse under section 42 of the Public Health Act, 1875.

Several of the Inspectors were engaged in an inquiry as to the measures of prevention adopted in parts of London in the face of an extended outbreak of small-pox, and at Eastbourne Dr. Sweeting inquired into the circumstances connected with the occurrence of cases of that disease.

The subject of oyster culture in relation to the occurrence of disease in man was one which occupied Dr. Bulstrode for several months of the year; his detailed inquiries and his visits to oyster beds, &c., along the English littoral being reported on in the special volume to which I have already referred.

Dr. Copeman continued his investigation of outbreaks of epidemic skin disease in poor law institutions in the Edmonton and West Ham Unions, and inquired also as to a fatal case of lead poisoning at Walworth, and as to alleged anthrax in in Leicestershire.

Additional local inquiries were held by the Medical Inspectorate in the following districts and localities with regard to the incidence of disease in particular places, and to questions concerning local sanitary administration:—As to prevalences of enteric fever at Brynmawr and Sunderland, by Mr. T. W. Thompson; at Chipping Wycombe and Quarry Bank, by Dr. Wheaton; in the Helmsley Rural District and at Raunds, by Dr. Bruce Low; at Loddon, by Dr. Copeman; at Phillack, by Dr. Reece; at Potterspury, by Dr. Bulstrode; and at West Bromwich and Wycombe Marsh, by Dr. Buchanan; as to prevalences of fatal diphtheria at Flint, by Dr. Reece; at Holbeach, by Mr. Evan Evans; and at Llanfynydd, by Dr. Sweeting. Inquiry was made as to the sanitary condition and administration of Exeter, Hetton-le-Hole and Brick Garth, and Thurmaston, by Dr. Fletcher; of Pembroke, by Dr. Reece; and of Poole, by Dr. Bulstrode; and in the cases of the county of Carnarvon and the Brecknock Rural District investigation was made of the working of the Medical Officer of Health arrangements, the first by Dr. Bruce Low and the second by Dr. Fletcher.

Inquiries were also instituted with reference to the pollution of the Rivers Dee and Brent by Drs. Bruce Low, and Copeman

respectively; and certain valleys of Monmouthshire and Glamorganshire were inspected by Mr. T. W. Thompson, with especial reference to sewerage arrangements and pollution of streams. Complaint by the County Council of Glamorgan with regard to the sanitary condition of Cowbridge, and by the Council of the County of Somerset as to the water supply of Lympsham, were severally made subject of investigation by Dr. Bruce Low and Mr. T. W. Thompson. Complaints against the East London Water Company were inquired into by Dr. Barry in association with Colonel Ducat, of the Engineering Department; and Dr. Theodore Thomson was associated with Mr. Tulloch, also of that Department, in an inquiry having reference to a proposal by the Town Council of Newport, Isle of Wight, to raise a loan for purposes of water supply. Inspection of the gathering grounds of the waterworks of the Rotherham Corporation was made by Dr. Thomson in view of certain proposals in a local Bill before Parliament.

Matters connected with the establishment of port sanitary authorities formed the subject of inquiry in the cases of Manchester, Hayle, and Penzance.

In App. A., No. 5, will be found an abstract of certain of the above inspections and inquiries, and I now proceed to treat more fully of such of them as call for more particular mention.

ENTERIC FEVER IN:— (a.) CHIPPING WYCOMBE.

Owing to recurring prevalences of enteric fever in the borough of Chipping Wycombe—generally known as High Wycombe—in Buckinghamshire, Dr. Wheaton was instructed to report on the circumstances with which the disease was associated. From the extracts of his report, which will be found at Appendix A., No. 6, it appears that enteric fever was found not to have been absent from the district for many years, and that an exceptionally widespread outbreak occurred in the autumn and winter of 1894, and was prolonged into 1895. The local Medical Officer of Health, reporting on the year 1894, estimated the number of attacks at about 50, on a population estimated at 14,500, but accurate knowledge as to the extent of any prevailing preventible disease was so far a matter of indifference to the town council, who constitute the Sanitary Authority of the district, that they had not cared to adopt the Act for the Compulsory Notification of Infectious Diseases. The result wes that Dr. Wheaton found it impossible to ascertain the actual number of attacks. Five deaths, however, resulted from this outbreak; and, on the assumption that the death-rate was somewhat high, the estimate of 50 attacks may be regarded as a reasonable one. But, whatever doubt there may have been as to the extent of the fever prevalence, there was none as to the existence in the town of conditions favourable to the diffusion of the enteric fever infection. These included faulty house drains; waterclosets—so-called—which were defective, and often foul, because they were very generally unprovided with a supply of water; and a very general resort, notwithstanding the existence of a public water service, to shallow wells, which were

liable to contamination by soakage of filth. Dr. Wheaton also found that no provision had been made by the Authority either for the isolation of cases of infectious disease, or for the disinfection of infected dwellings, drains, bedding, and other articles. But, from the etiological point of view, the most interesting point in connexion with the recurrence of enteric fever in High Wycombe lies in the circumstance that, under a sewerage scheme which was carried out in 1882, the sewage of the borough is conveyed by means of a main outfall sewer, for a distance of about two miles down the valley of the little River Wye, to a sewage farm situated above the village of Wycombe Marsh. At this farm the sewage is received into eight settling tanks, the sludge from which is drawn off into a sludge pit, to receive chemical treatment, before being pumped out on to the ground to dry; the more liquid sewage being made to flow directly on to a sewage farm of some 12 acres in extent. The effluent from this farm is collected by certain deep drains, and is discharged at several points into a small stream which joines the Wye.

(5.) WYCOMBE MARSH.

During the latter months of 1895 enteric fever broke out in the village of Wycombe Marsh, which, apart from some scattered houses having relations with the borough rather than with the village, contains a population of some 700 persons. From the beginning of October 1895 to the end of the first week of 1896, 24 attacks and two deaths occurred amongst the inmates of 19 houses, and Dr. Buchanan received instructions to report to the Board on the occurrence. The valley of the Wye at Wycombe Marsh is an alluvial level plain, nearly a quarter of a mile in width, which is watered by the Wye itself and also by a back river; the two streams flowing in a direction generally parallel to each other on either side of the valley. The village, which lies on a porous soil some 15 feet in thickness, is not drained; it is provided with cesspools, the contents of which largely soak into the ground; and the surface soil is further contaminated by reason of the more solid excreta being dug into it for garden purposes. Into this soil are sunk a few tube wells, and a number of dip-wells, none of which have any impervious steining; and almost everywhere the water rises to within from 6 feet to 3 feet of the surface.

Apart from such questions as community of occupation, personal intercourse, milk-pollution, or infection by other articles of food, all of which could be excluded with a very considerable degree of certainty, the sanitary circumstances of the village seemed, at first sight, amply to account for a maintained prevalence of enteric fever. But when the distribution of the disease came to be studied by Dr. Buchanan, it became evident that specific pollution, over a wide area, of the ground water of the village would alone afford a sufficient explanation of the various phenomena of the outbreak. In this connexion the relation of the High Wycombe sewage farm to the village water supply became matter for careful consideration.

That sewage farm occupies a position in the alluvial valley of the Wye just above Wycombe Marsh, and of the two streams which embrace the village, one—the Wye—abuts almost immediately on the farm, while the other—the "back river"—runs right through it. The sewage of High Wycombe is largely diluted with soil water, and the average daily amount discharged at the main outfall reaches some 2,000,000 gallons. One acre, or a little more, is usually under irrigation at the same time, the sewage attaining a depth of 2 or 3 inches on the surface of the irrigated land, whilst "under-drains" pour their contents rapidly into the back river which is here considerably below the level of the sewage farm. When Dr. Buchanan inspected this river its contents seemed to be just about doubled by the flow of "effluent" sewage. But the back river, which passes little more than 200 yards to the south of the village, is dammed up at Beech Mill above the level of the Wye, which flows immediately to the north; so that by reason of its height and the pervious nature of its banks, its contents escape in the direction of the village towards the Wye at a lower level. Both in this way and by reason of overflows at points in the back river, where the banks were defective, the water of this stream—so largely derived from the under-drains of the sewage farm, was found to flood the meadow between the back river and the village. This meadow had thus been under water during some weeks at the end of 1895. And, further, when the back river rose to a higher level than usually, the water in certain of the village wells had been similarly observed to rise.

If the Wycombe Marsh wells did, as matter of fact, become infected in the autumn and winter of 1895, by reason of a specifically infected sewage effluent from High Wycombe gaining access to them, the question naturally arises: Why did not Wycombe Marsh suffer sooner and conspicuously from enteric fever? The answer is: That up to September 1895 the Beech Mill had been disused and the upper part of the mill dam had been removed; so that the water in the back river had been able to flow away readily past Wycombe Marsh. The whole story of this fever prevalence, which I have only briefly summarised, will be found in Dr. Buchanan's report in Appendix A., No. 7. That report is the more interesting since it illustrates a danger which may devolve on one community as the result of works carried out solely in the interests of another community.

ENTERIC FEVER AT LODDON, NORFOLK.

The danger of using a water supply which at any moment may have added to its usual polluting agents the specific poison of enteric fever, is further illustrated by an outbreak of that disease which was investigated by Dr. Copeman. (*See* Appendix A., No. 8.) For 10 years prior to 1895 the little town of Loddon, in Norfolk, with its 1,100 inhabitants, had been entirely free from enteric fever, but after the importation of the disease in the person of a domestic servant, recently in service in

MEDICAL OFFICER'S REPORT.

a hospital where cases of enteric fever were at the time occurring, no fewer than 31 additional cases occurred. The maidservant in question sickened in Loddon about February 10th, two other cases followed in her own home, and then between April 17th and May 24th, there occurred 29 other attacks. Although there are probably between 60 and 70 surface wells in Loddon, 23 out of the 31 persons attacked later than the maidservant derived their water supply from the town pump, situated in the centre of The Green, and, with one exception, the remaining eight sufferers had admittedly had access, either repeatedly or occasionally, to the same water. Some of the attacks occurred amongst boys from outlying villages who took their mid-day meal at the Loddon school; and each such boy had resorted to the town pump for water. Indeed, it was easy to exclude other generally recognised causes of enteric fever; and, without denying the occasional influence of personal infection, &c., amongst members of infected households, to assign the bulk of the disease to the direct action of the water derived from the town pump. The precise method by which this water received its specific pollution must remain somewhat uncertain; but in discussing the question Dr. Copeman points out that a deep "soakage-well" containing some 15 feet of black mud was found at a distance of about five yards from the pump well, and that this "soakage-well" received, by means of a pipe-drain, all waste water thrown down a gully connected with the pump. Further proof of the view that the water from the town pump stood in the relation of cause to the prevalence of the enteric fever, is found in the circumstance that following on the failure of the pump, owing to a defective bucket, on April 23rd, and on the final disuse of the pump by order of the local authority on May 4th, the disease, within three and two weeks respectively of these two events, came practically to an end, and no recurrence of it took place subsequently. It should also be mentioned that analysis of a sample of this water, collected at a time when its mischievous influence must still have been at work, showed it to be chemically altogether unfit for drinking purposes.

DIPHTHERIA AT LLANFYNYDD.

During the period to which this report relates, Dr. Sweeting was instructed to report on a severe outbreak of diphtheria at Llanfynydd, in the Llandilofawr Rural District in Carmarthenshire. (*See* Appendix A., No. 9.) For some 14 years antecedent to 1894 deaths from diphtheria or from allied throat diseases had occurred from time to time in various parishes of the rural district; but in 1894, 13 deaths were definitely ascribed to diphtheria and eight other deaths to throat affections, such as membranous croup, laryngitis, &c. And not only so, but 12 of the 13 diphtheria deaths and one of the other fatal attacks, took place in the parish of Llanfynydd. This parish covers 10,850 acres, and has a population of 949 persons inhabiting 217 houses. It contains a village which occupies a picturesque position on the slopes of a valley watered by the Sannan, a tributary of the

River Towey, the village comprising 48 houses and a population of 142 persons; whereas the remainder of the population of the parish—807 persons living in 169 houses—occupy scattered farms and homesteads. Between November 1894 and March 1895 the greatest incidence of the disease was on the village. Thus, the house incidence on the village was 31·2 per cent. as opposed to 0·5 per cent. in the outlying part; the attack rate per population was 23·2 per cent. on the village and only 2·3 elsewhere; the mortality rates were 10·5 and 0·24 per cent. on the village and on the rest of the parish respectively; and the case mortality reached 45·4 per cent. in the village and 10·5 beyond its precincts. When the causes of this outbreak came to be investigated, it transpired that undefined throat illness had occurred amongst children attending the national school towards the end of October, 1894; and that, following on this, defined diphtheria came ultimately to be recognised, with the result that the school was closed on November 30th. But, by this time the mischief had been done; 52 attacks and 17 deaths took place between November 6th, 1894 and March 18th, 1895; and even then the disease could not be regarded as having altogether ceased. The sanitary circumstances throughout the whole parish of Llanfynydd were found to be faulty in the extreme. Dampness of habitations, ensured by reason of situation and by faulty construction, was a somewhat common feature; the water supplies were frequently such as to be necessarily exposed to constant risk of pollution; privy accommodation seemed in many localities to be looked upon as a superfluity, and in the village, where privies were more usual than elsewhere, they served to pollute both soil and air, and also to foul the Sannan stream by escape into it of their contents. There were no means of drainage, whilst refuse and filth of different descriptions took their share in bringing about nuisances, and in adding to the pollution of the stream.

The story of Llanfynydd is unfortunately by no means an uncommon one in the experience of the Department. It is one of persistent sanitary neglect, in which preventible disease, getting a foothold on the population before it is recognised, finds everything at hand to favour its fatal diffusion. There was no notification of infectious diseases available in order to give a timely warning; there was no provision ready for the isolation of first attacks in households when at last the disease was recognised; and the few measures that ultimately came to be adopted by the local authority, though in themselves desirable, could have had but little influence in checking the outbreak. But the story is interesting as showing anew the results of sustained apathy in sanitary administration, and it is of value as indicating how, under the conditions of such administration, or rather lack of administration, influences such as the close aggregation of dwellings, and the corresponding greater opportunities for personal communication which were afforded by the little village of Llanfynydd, as compared with

MEDICAL OFFICER'S REPORT.

the outlying portions of the parish, sufficed to give to its more concentrated sanitary faults a facility for retaining and diffusing disease which must always attach to village and town communities where the first principles of health are ignored.

DIPHTHERIA AND "PNEUMONIA" AT FLINT.

The returns of the Registrar General having shown that fatal diphtheria was present in the borough of Flint in the early part of 1895, Dr. R. J. Reece was instructed to report upon the occurrence. According to his report, Appendix A., No. 10, it appears that between the middle of February and mid-July 1894, 14 cases of illness referable to diphtheria or allied disease had been notified in a population of some 5,000 persons in the borough. After an interval of two months, during which no notifications of any such disease were received, cases were again recognised, and this in steadily increasing numbers. Indeed, by the end of December the total attacks had reached 46. Most of these cases had occurred in children, but some were in adults; and both classes included some who had concern with elementary schools, either as teachers or as pupils. The disease became much more widely prevalent in January 1895, during which month 24 persons are known to have been attacked, and the epidemic continued at least up to the end of July; there having been a total of 106 cases in the seven months, January—July 1895. There had been, in all, 152 attacks in 18 months, February 1894—July 1895, and of this number 26 cases terminated fatally; the attack rate on the population being over 30 per thousand. In 64 out of a total of 95 houses attacked, there was only a single case, and in most of the instances in which multiple attacks occurred there was evidence of the spread of the disease from one member of the household to another. At the date of Dr. Reece's visit, 288 children were in actual attendance at one of the [illegible] elementary schools in the district, and of this number no less than 113 admitted that they had suffered from "sore-throat," or glandular swellings styled "mumps," during the previous five months. Indeed, 84 of these children had been absent from school by reason of these ailments; but no system of exclusion of school closure had been adopted by the town council, and this notwithstanding the fact that at one stage of the outbreak the Medical Officer of Health advocated the closure of the schools. Several cases of inflamed throats were, on the same occasion, found amongst scholars and teachers. "Under circumstances "such as these," says Dr. Reece, "it can scarcely be wondered "at that school attendance has been the means of spreading "diphtheria in Flint." Interest attaches, however, to the relation of fresh notifications of diphtheria in successive weeks to various school stages including holidays, special aggregations of school children for examinations, &c. These points are set out in diagrammatic form by Dr. Reece. But in interpreting the diagram account has to be taken of multiple notifications of cases following each other in the same house, during periods of

school closure, the infection in the first attack having doubtless been brought about by school attendance.

MEDICAL OFFICER'S REPORT.

Dr. Reece also gives some account of an outbreak of sickness in which "pneumonia" was generally a prevalent feature, and which occurred in Flint and in the adjoining parish of Northop, during the months of February–July 1895. In all, 35 cases were heard of, 20 of them terminating fatally. The prospect of a fatal termination seems to have been out of all proportion to the amount of lesion detectable during life; and the precise nature of the disease remains obscure. It made its appearance whilst the population was suffering from privation and want, and whilst the town of Flint was undergoing a visitation of epidemic influenza. Dr. Reece did not succeed in seeing any of the cases; but from the histories communicated to him, there seems reason to believe that the disease was a form of that infective and epidemic pneumonia to which I have referred in two of my previous annual reports.*

"EPIDEMIC SKIN DISEASE."

In my report, for the year 1893–94 I reproduced a report by Dr. Copeman on occurrences of an epidemic skin disease in the infirmaries of certain metropolitan workhouses, and I drew attention to the circumstance that, in some of these institutions, the incidence of the disease had very suspicious association with the milk supply, which, in the case of four of the workhouse establishments implicated, was in the hands of the same contractor. During April and May 1895, skin disease associated with pyrexia, &c. appeared amongst the inmates of the Enfield Workhouse of the Edmonton Union, and Dr. Copeman was once more instructed to inquire into the circumstances. In his report, which will be found in Appendix A., No. 11, he explains that the disease in its incidence on persons of advanced age, in its clinical phenomena, in the absence of any proof of imported infection and otherwise, must be regarded as identical with the malady on which he formerly reported. The disease broke out on April 9th, and between that date and May 24th, there had been 28 well-marked attacks, out of a total of 158 inmates; all of them more or less infirm people. But these 158 inmates were divided into two classes. In the case of 92 of the 158, milk, to the extent of at least a pint a day, formed a part of their daily diet, and of these 92 no less than 26 suffered attack by the disease. The remainder of the inmates, 66 in number, had, with two exceptions, no other milk than the small quantity included in their tea, and the two exceptional inmates were the only ones, in addition to the 26 already named, who were attacked out of these 66; it also subsequently transpired that 14 other inmates, all of whom were amongst the 92 whose diet included an allowance of milk, had suffered from minor symptoms, corresponding very closely with those manifested in a series of doubtful cases which occurred in one of the

* Reports of the Medical Officer of the Local Government Board for the years 1891–92 and 1894–95.

MEDICAL OFFICER'S REPORT.

previous outbreaks of this epidemic skin disease. As already stated, the disease broke out on April 9th; the occurrence followed on the introduction of a new milk supply on March 31st; and the new contractor was the same one who had supplied four of the establishments in which the disease had prevailed in 1893-94. Dr. Copeman had no opportunity of procuring any examination of this milk during the period in which the cause of the disease was in operation; but it is known that at an early period of its delivery it had been refused by a number of the inmates on account of its offensive smell, and that when microscopically examined by the assistant medical officer of the institution on May 21st, three days before both the cessation of the outbreak and the discontinuance of the milk supply, it contained material which does not properly enter into the composition of milk. This occurrence adds confirmation to the opinion that this epidemic skin disease has, on more than one occasion, been related to the distribution, in workhouse infirmaries, of milk which cannot be regarded as normal in character. As yet, however, no opportunity has arisen for exact inquiry as to the changes to which the milk has been subjected before being delivered to the inmates of the institutions in question.

INSPECTION OF SOUTH WALES VALLEYS.

Early in 1896, the late Mr. T. W. Thompson completed a comprehensive report, which embodied the results of a detailed and careful inspection of the valleys of the Rumney, Sirhowy, Ebbw Fawr, Ebbw Fach, Ebbw, and the Afon Llwyd rivers, in the counties of Monmouth and Glamorgan. This inspection had been ordered by the Board in order to ascertain precisely what was the state, as regards drainage and sewerage, of the several districts comprised within these valleys, and for the purpose of acquiring further information as to the best means of remedying defects of sewerage and sewage disposal which had, from time to time, been brought under the notice of the Board. The inspection involved 93 miles of river, on or near the banks of which were scattered about a score of different sanitary districts, comprising, as far back as the Census of 1891, a population exceeding 175,000; and it included, amongst other matters, careful examination of the topography and geology of the areas involved, besides inquiry respecting a number of questions having concern with the social status of the people, and the occupations which they followed.

As regards the rivers themselves, it was found not only that they constituted the common sewers of the valleys through which they pass, but also that they very generally served as receptacles for coal-washings, refuse from tin-plate and iron works, polluting matters from all the ordinary trade processes, including those derived from slaughter-houses, breweries, fellmongers' yards, and gasworks; and that even solid trade products, ashes, &c. were tipped bodily into them. In short, the foul condition of these rivers has become a matter of serious

concern; the more pressing in view of the increase of population which has for some time past been going on along their banks, and which may be expected to undergo still further augmentation with the development of the coal industry of the district.

MEDICAL OFFICER'S REPORT.

In discussing the remedy for this state of affairs, Mr. T. W. Thompson took into consideration two alternative courses of procedure. Firstly, the execution of works of main sewerage and sewage disposal by the various district councils, acting either independently of each other, or, in particular cases, by two or more neighbouring districts jointly; and, secondly, the execution of amalgamated schemes of a larger character, comprising main trunk sewers extending throughout the whole length of the several valleys. The objections to a series of schemes of the former sort are not only numerous, but, in particular instances, all but insuperable; and hence he expressed a decided opinion in favour of a system of main trunk sewers for the several valleys, by means of which all liquid refuse from the existing and future centres of population would be kept out of the streams which are now fouled by it, and be conveyed under proper conditions to the Severn Estuary. Some such scheme had, it appears, already been submitted by the Monmouthshire county surveyor; but, like all proposals for dealing with a series of difficulties of very serious dimensions, it was not without drawbacks, financial, engineering, and other; and these led, for the moment, to the proposal being set aside.

Mr. T. W. Thompson's report consists of a paper dealing with the general considerations involved, and of a detailed description of the sanitary and other circumstances of each of the score of districts which he visited. The latter section of his report is primarily concerned with matters of local interest; but the former, which I reproduce in Appendix A., No. 12, deals with matters having much wider concern. It also serves to indicate the exceptional faculty which Mr. T. W. Thompson possessed of dealing with matters involving multifarious and far-reaching interests, and it emphasises anew the regret which is felt throughout the Department at the premature loss, by death, of a public servant whose work was always characterised by great ability and by devotion to duty.

RETURNS OF NOTIFIED INFECTIOUS DISEASES.

In Appendix A., No. 13, will be found a compilation, quarter by quarter for the year 1895, of the notified attacks and the certified deaths from certain infectious diseases. They have to do with 81 sanitary districts of England and Wales, in which these attacks and deaths admit of comparison. In the case of 44 sanitary districts of the metropolis the information is also set out week by week (Appendix A., No. 13 (*a*)).

II.—Cholera Prevalences.

In my last annual report I was able to announce that not a single death from Asiatic cholera had been recorded in this

country during 1894, and in continuation of the history of the western diffusion of cholera which invaded Europe in 1892, I submitted a detailed report by Dr. F. W. Barry on the circumstances of that diffusion in different countries of Europe during the year 1893. I had hoped to have been able to have embodied in this report a similar history for 1894; but I regret that I am prevented from so doing, owing to an accident which Dr. Barry met with in the performance of his official duties, and which has temporarily incapacitated him from completing the work which he had in hand on this subject. Under these circumstances I propose only to allude to the question of cholera in a few brief sentences, and to defer submitting a more detailed account of its movements.

During 1894 cholera continued to be severely epidemic in various portions of the Russian Empire, the disease causing upwards of 30,000 deaths. The greatest incidence of the epidemic was on Poland and other western portions of Russia in Europe. In Germany some 500 deaths occurred. In Galicia there was a very fatal epidemic, causing over 8,000 deaths, and Turkey-in-Europe, Belgium, Hungary, and Holland were seats of the disease. There were also evidences that cholera had not been extinguished in France.

During the year 1895 cholera caused some 12,000 additional deaths in Russia, the disease having largely prevailed in the provinces of Volhynia, Podolia, and Kieff. A fresh occurrence of the disease took place in Galicia, and both in the European and Asiatic provinces of Turkey new cholera centres manifested themselves. Cholera was also imported into Egypt, and although the disease subsided during the winter months, it broke out anew in epidemic form early in 1896. The disease also appeared during 1895 at Tangier, in Morocco, the infection having apparently been conveyed there by pilgrims returning from Mecca. Amongst other occurrences of cholera in more distant parts of the world, a widespread epidemic in Japan was by far the most serious.

During the course of 1895, 31 vessels "infected with cholera" in the sense of the Board's Cholera Regulations, reached three English ports. In each case the usual measures of prevention were adopted; and once more the year passed without the spread of cholera to anyone living in this country.

III.—Auxiliary Scientific Investigations.

I noted in my Cholera Report for 1893 the general consensus of opinion that, in true (Asiatic) cholera *alone*, is Koch's vibrio found inhabiting the human subject; that bacteriologists, whether they belonged to the larger section of observers accepting Koch's comma as the *vera causa* of cholera, or were among the few disposed to regard the vibrio as rather a consequence than the cause of the malady, had become agreed as to the importance, for diagnostic purposes, of detecting in the dejecta of persons suffering attacks of a cholera-like nature,

the presence of Koch's comma bacillus. And I went on to consider from this bacteriological view point, the cholera occurrences in one and another quarter of this country which, during the year in question, had been reported on by Dr. Klein. There was reason, as will duly appear, for examination in this sense of the cholera occurrences of 1893.

In all years, in this country, there are observed, especially in the autumn season, attacks of illness which, in their clinical features and as regards the appearances presented by the viscera after death, are indistinguishable from true (Asiatic) cholera. From that disease such attacks are differentiated solely by the circumstances under which they take place. They tend to occur sparsely, and as isolated cases diffused over the country, instead of, as with Asiatic cholera, in groups in particular localities; moreover, the antecedents of the persons attacked are such as to forbid belief in their having been exposed to cholera infection imported from abroad. English cholera—"cholera nostras"—is our name for such cases, and they vary in severity between an illness fatal in a dozen hours, and one no more dangerous than a smart attack of diarrhœa.

The reputed cholera cases in England in 1893, as judged by bacteriological examination of their dejecta or their bowel contents, were found to be broadly divisible into two classes; namely, cases the material from which, on submission to bacterial test, yielded unmistakable evidence of the presence of Koch's vibrio, and cases in regard of which this microbe could not be detected, by any means open to the bacteriologist, in the dejecta or bowel contents of the sufferers. Bacteriologically, therefore, cases of the former sort had to be regarded as true, cases of the latter sort as *not* true cholera.

From the administrative point of view, however, this result was by no means satisfactory. On the authority of bacteriology we were being called on to regard certain cases thought to be true cholera, as not true cholera; and at the very same time we were being told that other cases not considered to be true cholera were nevertheless unequivocal examples of that disease. For instance, not only did the class of material which yielded Koch's vibrio comprise in 1893 cases which had not been regarded clinically as true cholera, but also it comprised cases, some presenting clinically symptoms by no means characteristic of cholera, the antecedents of which seemed almost to preclude the suspicion that the sufferers had been exposed, directly or indirectly, to the infection of cholera imported from abroad. Administratively, indeed, questions arose such as the following:—

What, on the one hand, is our justification for urging local authorities to deal with cholera-like cases, wherein the bacteriological verdict is *positive*, however innocent their antecedents or ambiguous their symptoms, as examples of a disease calling for strenuous effort in preventing its extension—in ways that true cholera does, we know, spread; and what right have we,

on the other hand, to encourage local authorities to regard cholera-like cases, as to which the bacteriological verdict is *negative,* as having, however suspicious their antecedents and their symptoms, no epidemic significance, and as *not* calling, therefore, for action other than the every-day action which it is customary to adopt in regard of commonplace diarrhœal illness ?

In its latter aspects, the question thus raised had very especial concern for local authorities, since the administrative measures which are necessary for the control of cholera derived from abroad are so much more costly and far reaching than those which suffice where indigenous or English cholera is alone concerned. It will be remembered indeed that, as a matter of precaution, the Board in 1893, during the prevalence of true cholera on the Continent and while that disease was manifesting itself here and there in our midst, inculcated on local authorities the practice of dealing with cholera seizures of all sorts as if each such attack were potentially the beginnings of epidemic cholera. But now it was seen that if bacteriology is to be trusted to differentiate, for our purposes, between true cholera and false or indigenous cholera, the precautions enjoined by the Board in 1893 must needs have been not infrequently in excess of those actually called for. Upon all grounds, therefore, it behoved the Board to learn, by investigation on a sufficient scale and over a wide area, what is the value of bacteriological evidence *negative* of cholera; to ascertain, for instance, whether the casual cholera manifesting itself summer and autumn in this country in years when the presence of exotic cholera is practically out of question, *fails always to yield,* on bacteriological test, *Koch's comma bacillus.* Accordingly, investigation of our indigenous cholera was duly undertaken in the above sense, during 1894–95 and 1895–96. (Appendix B., No. 1.)

In 1894 Dr. Klein had submitted to him for bacteriological examination material from 16 reputed cholera cases. It was to be expected that 1894, being the year next succeeding that in which some true cholera had exhibited itself in several quarters of this country, would afford examples of recrudescent cholera in localities previously invaded. As the summer advanced, therefore, the Medical Department was on the look-out for such occurrence. The very first reputed cholera case of which we had notice in 1894 made its appearance in the Rowley Regis district, where in 1893 true cholera had manifested itself as a limited outbreak; and later on Grimsby and London, both also affected by cholera in 1893, each supplied us with material from more than one case. For the rest, the 1894 "cholera" cases that came under observation occurred in widely separated localities, as for instance Monk Bretton, Middlesbrough, Swansea, and Spalding. The 16 cases in question were of various types. Not a few were, from their clinical symptoms, locally regarded as unequivocal cholera, and some occurred in circumstances and in localities strongly suggestive of their relation to antecedent

cholera of this class. But whatever their clinical features, whatever the localities in which they occurred, and whatever the pathological appearances of the material from them submitted for bacteriological examination, they one and all failed to yield on most rigid scrutiny a single specimen of Koch's cholera-vibrio. From the bacteriological point of view, therefore, none of them were true cholera; a verdict not without justification in the circumstance that in no instance did they give rise to further cholera cases.

The experience of 1895 was precisely similar. Thirteen reputed cholera cases came under observation during the year. As before, the cases were of various types, and they occurred in widely separate localities some of which had suffered cholera in 1893. But again, in no single instance could Koch's cholera vibrio be detected by most diligent search in the bowel contents of the sufferers. Once more, therefore, every one of the reputed cholera cases coming under notice in a whole year was declared on bacteriological authority *not* to be true cholera.

There can be no question then, I think, as to the value of bacteriological testimony in aid of determining the actual nature of reputed cases of cholera. Should cholera again establish itself on the Continent of Europe, and by so doing threaten this country, we are now able, by aid of Dr. Klein's researches, to assist local authorities with a greater degree of confidence than heretofore in regard of cholera-like disease newly appearing in their districts; to advise, for instance, whether, *administratively*, such disease should be dealt with in the exceptional fashion necessary where epidemic cholera is in question, or whether it may reasonably be met by those every-day methods which it is customary to apply on the manifestation in a locality of indigenous diarrhœal disease.

Passing now from the *negative* bacteriological evidence afforded by the 29 cases studied by Dr. Klein in the two years in question to *positive* aspects of these cases in their bearing on the etiology of English cholera, the following facts would appear especially worthy of consideration. Though Dr. Klein could not detect in the bowel contents (or dejecta) of a single one of the numerous cases definitely regarded as choleraic in nature, any comma bacillus whatever, he nevertheless found that in material from these cases Koch's vibrio was, so to speak, replaced by other microbes. These were mainly bacillus coli and proteus vulgaris. More commonly the former was the predominant micro-organism, but now and again the two species were intermixed in the bowel contents in nearly equal proportion. In certain of the cases bacillus coli was profusely abundant, almost to the exclusion of all other bacteria. Samples from such bowel contents presented as cover glass specimens bacillus coli in absolutely pure culture; and, what is more, they showed the bacilli in question distributed through the intestinal flakes in the "fish-in-stream" arrangement which has been considered peculiar to Koch's vibrio, and as absolutely diagnostic, therefore, of true cholera. English

cholera cases of this class were mainly cases which clinically had closely simulated true cholera. Moreover, in other respects, especially as regards the physical aspects of the viscera and bowel contents, these cases had not appeared distinguishable from true cholera. In a word, they differed from that disease solely in the circumstance that the predominant micro-organism which exhibited in the intestinal flakes the "fish-in-stream" arrangement, was not Koch's vibrio but bacillus coli. What may be the meaning of this observation has yet to be learned. But it may be not without significance that the "cholera" cases furnishing material of the above description occurred for the most part in localities wherein during 1893 true cholera had made itself manifest.

Other work by Dr. Klein on Cholera and Diarrhœa during 1895-96 has included observation of an outbreak of the latter malady at St. Bartholomew's Hospital. The diarrhœa in question was referred, on circumstantial evidence of much cogency, to a section of the milk supply of the institution. Alike in a sample of the particular milk and in the dejecta of sufferers by the outbreak, Dr. Klein found in abundance an anaërobic spore-bearing bacillus having pathogenicity for rodents. Hitherto this anaërobic bacillus had not been met with in the dejecta of diarrhœa cases, nor indeed have anaërobic bacteria been studied in this connexion. The life history of the microbe in question and its properties, are to be made further subjects of study by Dr. Klein.

PROTECTIVE INOCULATION.

For several years Dr. Klein has insisted on the different value of protective inoculation, according as the *protoplasm* or the *metabolic products* of the microbe of experiment are separately employed for conferring "immunity" on an animal that is subsequently to be tested as to its resistance to the particular living infection. Rodents "prepared," as the phrase is, by repeated inoculation in small amount with the bacillary bodies of one and another microbe, have been demonstrated by him, in regard of several different infections, to be unquestionably immune against an ordinarily fatal dose of the actual microbe of experiment, though not necessarily against its toxin. Rodents, on the other hand, "prepared" by repeated injection of small amounts of toxin, though they are hereby enabled to resist subsequently an ordinarily fatal dose of that toxin, are not necessarily at the same time secured against the multiplication within their tissues of the microbe which, outside the animal body, has produced the toxin in question. In the case of certain infections, it is true the toxin of the microbes upon which they depend does, as matter of fact, exercise some germicidal, and, so far, some prophylactic, as well as definite antitoxic, and, to that extent, curative property. Nevertheless, there have appeared grounds for regarding the chemical substances bound up with the intracellular protoplasm of not a few microbes and the chemical substances resulting from their life processes, as possessing separate and distinct physiological

activities. Distinction, therefore, in the preparation of so-called antitoxic serum between protoplasm and product may, Dr. Klein perceived, have important practical bearing. The blood serum, for instance, of an animal immunised with a given *toxin* might be suspected to be of value chiefly as a *curative* agent, *i.e.*, for the purpose of neutralising, in another animal, similar toxin already produced in or introduced into its tissues. And conversely, the blood serum of an animal immunised by means of the bacillary bodies of a given microbe might be preferable as a *protective* agent, *i.e.*, as a germicide of that microbe, should the latter subsequently obtain entrance to the tissues of the animal to which the blood serum in question has been administered.

PROPHYLAXIS IN DIPHTHERIA.

In this connexion, and with special reference to prophylaxis in diphtheria, Dr. Klein has, in 1895–96 (Appendix B., No. 2), tested further the protective values of diphtheria serum, such as he was able speedily to obtain in the previous year by repeated injection of the horse with living diphtheria culture, and of diphtheria serum much more slowly obtained by repeated injection of that animal solely with the metabolic products (toxin) of the diphtheria microbe. Testing, in the first instance, serum of the one and the other sort, as a direct germicide to the diphtheria bacillus, Dr. Klein *simultaneously* inoculated guinea pigs with the serum of experiment and an ordinarily fatal dose of living diphtheria bacilli. As a result, he found that diphtheria serum, in whichever way prepared, proved, if only it was used in sufficient amount, a satisfactory germicidal agent. In this sense, however, no one of the serums he was employing appeared greatly superior to another, though, bulk for bulk, serum obtained in the course of a few weeks by injecting an animal with the bacillary bodies of the diphtheria microbe had some advantage over serum obtained in the course of several months by repeated injection of an animal with diphtheria toxin. Next, Dr. Klein proceeded to test these different diphtheria serums as to their ability to protect rodents against the diphtheria process, when an interval of greater or less length is allowed to elapse between injection of the protective serum and administration of an ordinarily fatal dose of living diphtheria culture. Again there was practically little difference discoverable in the potency of diphtheria serum prepared in the one and the other way. Each several serum employed by Dr. Klein served to protect his experimental animals against the diphtheria process for a limited period only, a period which in no case exceeded one week. Furthermore, the amount of serum required for inducing in rodents this condition of very temporary protection was relatively so large as practically to forbid anticipation of useful results from an application of the method to the human subject.

GERMICIDAL ELEMENT IN BLOOD SERUM.

In further elucidation of the source of the germicidal element thus demonstrated as present in blood serum, Dr. Klein (Appendix B., No. 3) studied in particular, and in regard of the

typhoid bacillus and Koch's vibrio as well as bacillus diphtheriæ, germicidal serum obtained *solely* by injection of the intra-cellular substance of microbes. And he found, as he anticipated, that both typhoid serum and cholera serum, effective in each instance as a directly germicidal agent, may be readily obtained by injection of the experimental animal with the *sterilized protoplasm* of the one and the other microbe. He has not, however, yet tested the prophylactic, as contrasted with the directly germicidal, potency of each such serum; but, in view of his experience in diphtheria prophylaxis, it may be suspected that, as protective agents, serums prepared in this way are by no means trustworthy. Indeed, in regard of most of the infections which so far have been under investigation in the above sense, a serum which may be relied on to afford any durable protection against attack is still a desideratum.

SNAKE VENOM.

With reference to blood serum in its other aspect, namely, as an agent neutralising, in a given animal, toxin already produced in or introduced into its tissues, Dr. Kanthack (Appendix B., No. 4) has made some interesting observations on snake venom. It has been affirmed by certain observers that by repeated inoculation of rabbits and other animals with small doses of cobra venom, a serum can be obtained that will not only secure other and similar animals against an ordinarily fatal dose of cobra venom, but will also protect them against all other snake poisons of whatever sort. Similarly it has been affirmed that antitoxic serums other than "cobra antitoxic serum," as, for instance, tetanus and abrin serums, are capable of neutralising, at least *in vitro*, the cobra venom. Dr. Kanthack, taking note of these statements, deals in his report principally with the action of different kinds of serum on the poison of different sorts of venomous snakes. From study of the literature of the subject, he shows that there is some reason to believe that cobra antitoxic serum may be capable of neutralising the poison of many kinds of venomous snakes, for the reason that the physiological action of the poison of these other snakes is the same as, or not greatly different from, that of the cobra poison. On the other hand there are certain of the venomous snakes, the poison of which appears to have a physiological effect wholly different from cobra venom, and recorded experiments with the poison of snakes of this latter class do not, in Dr. Kanthack's view, establish that the poison in their case is capable of being neutralised by cobra antitoxic serum. Dr. Kanthack finds confirmation of this inference in the circumstance that various species of snakes exhibit very considerable differences in their power of resisting each other's venom.

Dr. Kanthack also records certain experiments in which he endeavoured to obtain evidence of the ability of chlorinated lime to neutralise cobra venom within the animal body, and he has also sought to produce, by injections of solution of chlorinated lime, in the way recommended by Calmette, a serum antitoxic to cobra venom. These endeavours have, however,

been altogether without success. He further records other experiments, designed to test the statement that certain antitoxic serums are in each instance capable of neutralising, *in vitro*, poisons other than their so-called specific poison. Here, again, his experiments have had negative result. Finally, in certain observations which he appends to his report, Dr. Kanthack indicates how strong a confirmation of the view that antitoxic serums have a specific action is afforded by the results of the recent "serum tests" devised by Pfeiffer, Bordet, and Durham.

FOOD POISONING.

Food poisonings such as have now and again come under notice of the Board have appeared to be of two classes—food poisoning referable to the presence in the implicated food of the deleterious products of bacteria which multiplied therein before it came to be swallowed, and food poisoning due to similar deleterious material manufactured as it were in the intestines of the sufferers by living bacteria swallowed along with food. As to food poisoning of the latter class, sometimes one, sometimes another microbe has been found pervading, almost to the exclusion of other bacteria, the bowel contents or the dejecta of the persons attacked, and in circumstances strongly indicative that the given microbe has had important concern in the illness witnessed. Nevertheless, in no instance has the seemingly implicated microbe, when it has come to be studied in detail, proved other than a bacterium reputedly innocent of harm, so far as the human subject is concerned—as for instance bacillus coli or some variety of proteus, both of which normally occur in small amount in the intestine of man. Accordingly, question arises whether the discovery of so excessive a quantity of these reputedly harmless microbes indicates that, under exceptional conditions, these common saprophytes—or certain varieties of them—are capable either of becoming themselves toxic to man or of enhancing the activity of some potentially baneful microbe which may be introduced along with food into the alimentary tract. It thus becomes needful to consider what may be the conditions which at one time favour, at another time discourage, multiplication within the human bowel of commonplace saprophytes, and which may tend in corresponding degree to enhance or to annul their physiological activities. In view indeed of all the circumstances there has appeared ground for suspecting that while there probably are food bacteria which mutually destroy each other when they meet together in the intestine, there are also others which, within the bowel, enhance one another's activities, with the result that, under circumstances which can only be exceptional, some potentially harmful microbe is enabled to greatly multiply there, thus poisoning the common host.

This aspect of food poisoning has (Appendix B., No. 5) engaged the attention of Dr. Cautley in 1895-96. The particular microbes which he has studied have been bacillus coli and proteus vulgaris, both of which, as has been said, occur normally to a limited extent in the human intestine. Each of these he has tested in reference to its growth and activity when

associated with commonplace non-pathogenic food bacteria, such as yeast, oidium albicans, bacillus lactis, bacillus aceti, and mycoderma aceti. In artificial culture media, not one of the above food bacteria was found by Dr. Cautley to exercise any influence at all on the growth of bacillus coli or of proteus. When, however, the living tissues of rodents were adopted as culture ground instead of artificial media, it was otherwise; in nearly every instance the food bacterium of experiment tended to promote the life processes of both bacillus coli and proteus, and to enhance the virulence of these microbes in rodents. But feeding experiments of parallel sort, which were undertaken on mice, proved negative; none of these animals suffered illness or inconvenience as a result of introduction of mixtures of these various bacteria into their alimentary systems.

GLYCERINATED VACCINE LYMPH.

The issue of the Report of the Royal Commission on Vaccination, to which I have already referred, gives importance to certain experiments which have been made from time to time as to the admixture of glycerine with vaccine lymph. For more than a quarter of a century it has been an occasional practice to add glycerine to lymph, both of animal and human origin; and it had gradually come to be observed that the augmentation thus secured in the quantity of lymph available could often be attained without diminution in the active properties of the lymph.

But it was not until 1891, when Dr. S. Monckton Copeman, now one of the Medical Inspectors of the Board, read a paper on the subject before the International Congress of Hygiene, held in London that year, that it came to be understood that the careful preparation, with glycerine, of vaccine lymph, which had been derived from the calf, not only left the resulting vaccine material as active as the lymph itself had been before the admixture, but that the glycerine exercised, in the course of some four or five weeks of careful storage of the material, a germicidal influence on the extraneous microbes commonly met with in vaccine lymph. In particular experiments, when pathogenic microbes such as the bacillus of diphtheria, the bacillus of tubercle, and the streptococcus of erysipelas were purposely mixed in considerable quantity with the lymph material, these organisms were found to be destroyed in a month, or less, in a lymph emulsion containing some 30 to 40 per cent. of glycerine. In Appendix C. Dr. Copeman gives an account of the history of this subject, and he relates some of the experiments which he and Dr. Blaxall have carried out in certain studies they have made in this matter. Dr. Blaxall also records a series of experiments which he has recently made for the purposes of the Board on the action of glycerine, vaseline, and lanoline, on "pulp" derived from vaccine inoculations on the calf. These experiments go to confirm the results obtained by Dr. Copeman when working with an emulsion of glycerine and vaccine lymph. They further show that, whatever conveniences may at times arise from the substitution for glycerine of either vaseline or lanoline, these two latter preparations cannot replace glycerine in the important influence which

that substance possesses in destroying extraneous micro-organisms found in or added to vaccine lymph, whilst leaving its activity for the purposes of vaccination absolutely intact.

Since 1891 several European Governments have undertaken the preparation of glycerinated vaccine lymph. After storage for a sufficient time the resulting emulsion has to pass the test of a bacteriological examination, and it is then issued for the purposes of vaccination. The whole subject is, on your instructions, being further investigated.

I have the honour to be,
Sir,
Your obedient Servant,

June 1897. R. THORNE THORNE.

APPENDICES.

APPENDIX A.

No. 1.

Digest of the Vaccination Officers' Returns with regard to Children whose Births were registered in the Year 1893.

The following is a summary of the twenty-second annual return under the Vaccination Act, 1871. Of 914,557 births returned to the Board by the several Vaccination Officers in England and Wales, as registered during the year 1893, the number which, at the time the return was made, had been registered as successfully vaccinated was 661,513 (being 72·3 per cent. of the whole), and the number registered as having died unvaccinated was 102,442 (or 11·2 per cent. of the whole). Of the remaining 150,602 children, 3,394 (or 0·4 per cent. of the whole) had been registered as insusceptible of vaccination; 39 (or 0·004 per cent.) as having contracted small-pox before they had been vaccinated; 13,845 (or 1·5 per cent.) as having their vaccination postponed by medical certificate; leaving 133,324 (or 14·6 per cent.) as "removed," "not to be traced," or otherwise unaccounted for. If from the 914,557 births returned by these officers deduction be first made of the deaths that took place before vaccination, it appears that of the surviving 812,115 children, there were registered at the time of the return 81·5 per cent. as successfully vaccinated; 0·4 per cent. as either insusceptible of vaccination, or as having had small-pox; and 1·7 per cent. as under medical certificate of postponement; leaving 16·4 per cent. as at that time still unaccounted for as regards vaccination.

The proportion of cases unaccounted for in the metropolitan returns for 1893 is 18·2 per cent.; in the provincial returns, 15·7 per cent. Of the registered births of the twenty-two years 1872–93, the proportion not

App. A. No. 1.

Digest of Vaccination Officers' Returns, 1893.

finally accounted for in regard to vaccination in each year respectively has been as follows:—

—	Metropolis.	Rest of England.	—	Metropolis.	Rest of England.
1872	8·8	4·5	1883	6·5	4·9
1873	8·7	4·2	1884	6·8	5·3
1874	8·8	4·1	1885	7·0	5·5
1875	9·3	5·8	1886	7·8	6·1
1876	6·5	4·0	1887	9·0	6·7
1877	7·1	4·1	1888	10·3	8·2
1878	7·1	4·3	1889	11·6	9·6
1879	7·8	4·5	1890	13·9	10·9
1880	7·0	4·5	1891	16·4	12·9
1881	5·7	4·3	1892	18·4	14·3
1882	6·6	4·5	1893	18·2	15·7

—	Metropolis.	Rest of England.
Average of 5 years, 1873–77 - - -	8·1	4·1
" " 1878–82 - - -	6·8	4·4
" " 1883–87 - - -	7·4	5·7
" " 1888–92 - - -	14·1	11·2

In 1893 the proportion of cases unaccounted for, after deduction of the postponed cases, in the Metropolis and in the rest of the kingdom, was 16·9 and 14·2 per cent. respectively.

For purposes of comparison, an addition has been made to the tables, showing the total number of cases unaccounted for during the previous five years, with the proportion which such cases bear to the entire number of births registered.

	Returns, 1893.								Children remaining "unaccounted for" when the Returns for the several Years were received.	
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of Births.	*Total Number for the Years 1888–92.*	*Average Per-centage for the Years 1888–92.*
ENGLAND & WALES -	914,557	661,513	3,394	39	102,442	13,845	133,324	16·1	*518,763*	*11·7*
Ditto (excluding Metropolitan Unions).	781,474	567,474	2,687	37	88,269	12,151	110,856	15·7	*425,703*	*11·2*
Metropolitan Unions -	133,083	94,039	707	2	14,173	1,694	22,468	18·2	*93,060*	*14·1*
COUNTIES.										
England:										
Bedford - - -	4,527	1,330	11	—	562	27	2,597	58·0	*7,565*	*32·3*
Berks - - -	7,534	6,305	22	—	598	153	456	8·1	*2,551*	*6·9*
Bucks - - -	4,725	3,423	11	—	412	61	818	18·6	*1,248*	*5·2*
Cambridge - -	5,369	4,534	12	—	489	156	178	6·2	*1,312*	*4·8*
Chester - - -	21,863	17,868	108	1	2,480	239	1,167	6·4	*4,881*	*4·7*
Cornwall - - -	8,527	5,753	7	—	1,023	128	1,616	20·5	*5,172*	*11·8*
Cumberland - -	8,171	6,479	11	—	851	230	600	10·2	*3,164*	*7·6*
Derby - - -	14,907	9,526	36	1	1,663	172	3,509	24·7	*8,155*	*11·9*
Devon - - -	17,152	14,016	46	—	1,679	289	1,122	8·2	*5,799*	*6·7*
Dorset - - -	4,981	4,005	10	—	346	82	538	12·4	*2,243*	*8·9*
Durham - - -	38,431	28,985	86	1	4,672	649	4,038	12·2	*17,266*	*9·4*
Essex - - -	25,782	19,007	84	—	2,364	563	3,764	16·8	*14,004*	*11·7*
Gloucester - -	15,877	9,851	61	2	1,561	448	3,951	27·7	*14,180*	*18·3*
Hereford - - -	3,129	2,584	2	—	290	71	182	8·1	*882*	*5·8*
Hertford - - -	7,150	5,421	24	1	552	61	1,091	16·1	*3,685*	*10·5*
Huntingdon - -	1,303	1,147	3	—	115	5	33	2·9	*217*	*3·2*
Kent (extra-metrop.) -	22,505	17,955	89	9	1,994	388	2,070	10·9	*9,779*	*8·6*
Lancaster - -	132,515	91,839	505	5	17,232	2,006	20,928	17·3	*76,029*	*11·7*
Leicester - - -	12,457	2,053	13	1	1,927	39	8,424	67·9	*32,118*	*52·9*
Lincoln - - -	13,443	9,853	66	—	1,552	352	1,620	14·7	*4,903*	*7·4*
Middlesex (ex.-metrop.)	16,838	12,806	138	—	1,596	274	2,024	13·6	*9,070*	*11·5*
Monmouth - -	10,120	7,866	20	—	1,039	344	851	11·8	*3,298*	*7·0*
Norfolk - - -	13,200	8,203	19	—	1,508	145	3,325	26·3	*8,751*	*13·2*
Northampton - -	9,319	3,039	3	—	1,106	69	5,102	55·5	*19,060*	*41·1*
Northumberland -	17,625	13,605	62	—	2,077	491	1,390	10·7	*6,488*	*7·9*
Nottingham - -	17,362	12,743	52	—	2,035	248	2,284	14·6	*9,481*	*11·6*
Oxford - - -	5,249	3,854	12	—	485	77	821	17·1	*3,113*	*11·8*

—	Returns, 1893. Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of Births.	Children remaining "unaccounted for" when the Returns for the several Years were received. Total Number for the Years 1888–92.	Average Percentage for the Years 1888–92.
COUNTIES—*cont.*										
ENGLAND—*cont.*										
Rutland - - -	536	464	1	—	44	10	17	5·0	*95*	*3·5*
Salop - - -	7,012	5,930	14	—	621	76	371	6·4	*1,627*	*4·7*
Somerset - -	14,564	11,022	40	1	1,326	322	1,853	14·9	*8,834*	*12·3*
Southampton - -	18,619	15,366	106	—	1,568	254	1,325	8·5	*6,910*	*6·7*
Stafford - - -	34,908	25,156	113	1	4,550	548	4,540	14·6	*13,865*	*8·4*
Suffolk - - -	10,273	8,269	24	—	1,000	164	816	9·5	*4,083*	*7·7*
Surrey (extra-metrop.) -	15,213	11,637	56	—	1,287	388	1,845	14·7	*8,849*	*11·9*
Sussex - - -	14,124	10,555	45	—	1,237	225	2,062	16·2	*8,616*	*12·4*
Warwick - - -	25,525	17,928	90	11	3,303	253	3,940	16·4	*12,881*	*10·4*
Westmorland - -	1,766	1,563	5	—	146	22	30	2·9	*267*	*3·0*
Wilts - - -	7,155	5,236	13	—	521	210	1,175	19·4	*2,964*	*8·2*
Worcester - -	18,873	15,054	85	—	2,045	185	1,504	8·9	*4,780*	*5·2*
York, East Riding -	12,780	10,131	54	1	1,608	110	876	7·7	*4,302*	*6·9*
York, North Riding -	10,677	8,357	37	—	1,303	138	842	9·2	*3,958*	*7·3*
York, West Riding -	77,500	53,286	410	2	9,713	751	13,338	18·2	*58,989*	*15·8*
WALES:										
Anglesey - - -	912	790	—	—	82	8	32	4·4	*177*	*4·1*
Brecknock - -	1,617	1,344	—	—	157	24	92	7·2	*436*	*5·6*
Cardigan - - -	1,666	1,403	1	—	177	25	60	5·1	*364*	*4·5*
Carmarthen - -	4,198	3,646	2	—	441	48	61	2·6	*571*	*2·8*
Carnarvon - -	3,248	2,617	4	—	397	54	176	7·1	*909*	*5·8*
Denbigh - - -	2,984	2,519	6	—	339	47	73	4·0	*568*	*4·3*
Flint - - -	2,495	2,107	2	—	262	36	88	5·0	*661*	*5·7*
Glamorgan - -	28,358	23,702	63	—	3,302	353	938	4·6	*5,467*	*4·4*
Merioneth - -	1,746	1,468	—	—	201	47	30	4·4	*343*	*4·0*
Montgomery - -	1,816	1,599	2	—	131	35	49	4·6	*365*	*4·1*
Pembroke - -	2,370	2,004	—	—	246	43	77	5·1	*717*	*6·1*
Radnor - - -	478	268	1	—	54	8	147	32·4	*341*	*14·6*

METROPOLITAN UNIONS.	Returns, 1893.								Children remaining "unaccounted for" when the Returns for the several Years were received.	
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	*Total Number for the Years 1889–92.*	*Average Per-centage for the Years 1889–92.*
Bethnal Green	4,756	1,513	4	—	635	37	2,567	54·8	*8,026*	*32·6*
Camberwell	7,479	5,645	20	—	826	212	776	13·2	*4,964*	*13·6*
Chelsea	2,854	2,225	24	—	268	19	318	11·8	*1,306*	*9·1*
Fulham	6,673	5,225	45	—	770	64	569	9·5	*1,864*	*6·1*
George, St., Hanover Sq.	2,847	2,454	27	—	267	18	81	3·5	*596*	*3·8*
George, St., in the East	1,966	1,500	1	—	253	30	182	10·8	*755*	*8·1*
Giles, St., and St. George	1,101	772	9	—	107	10	203	19·3	*1,059*	*18·0*
Greenwich	5,381	4,409	38	—	553	61	320	7·1	*4,488*	*16·6*
Hackney	6,925	2,642	21	—	604	35	3,623	52·8	*9,982*	*29·6*
Hampstead	1,516	1,251	32	—	131	13	89	6·7	*457*	*6·2*
Holborn	4,767	3,585	18	—	485	43	636	14·2	*3,103*	*12·1*
Islington	9,757	7,251	38	—	1,222	132	1,114	12·8	*4,971*	*10·4*
Kensington	3,667	2,959	23	1	346	52	286	9·2	*1,679*	*8·4*
Lambeth	9,221	6,345	40	—	993	143	1,691	19·9	*6,886*	*15·2*
Lewisham	2,480	2,072	35	—	205	13	155	6·8	*746*	*6·3*
London, City of	629	504	7	—	60	2	56	9·2	*340*	*9·3*
Marylebone	4,374	2,837	12	—	440	9	1,076	24·8	*2,872*	*10·2*
Mile End Old Town	4,158	1,874	20	—	457	—	1,807	43·5	*6,758*	*33·3*
Olave, St.	4,987	3,577	8	—	581	88	733	16·5	*3,806*	*15·3*
Paddington	3,015	2,421	27	—	265	10	292	10·0	*1,918*	*13·2*
Pancras, St.	7,039	5,266	35	1	621	242	874	15·9	*5,122*	*14·2*
Poplar	5,918	3,867	59	—	627	56	1,309	23·1	*5,635*	*18·9*
Saviour, St.	7,286	5,247	26	—	926	77	1,010	14·9	*4,687*	*13·2*
Shoreditch	4,460	3,172	11	—	556	23	698	16·2	*1,723*	*7·6*
Stepney	1,954	1,220	11	—	211	33	479	26·2	*1,365*	*13·7*
Strand	492	372	—	—	59	7	54	12·4	*339*	*12·2*
Wandsworth and Clapham	9,811	7,509	83	—	1,023	196	1,000	12·2	*6,569*	*14·1*
Westminster	854	539	4	—	72	45	194	28·0	*704*	*15·7*
Whitechapel	3,109	2,676	4	—	265	6	158	5·3	*462*	*3·3*
Woolwich	3,607	3,110	16	—	345	18	118	3·8	*688*	*3·6*
	133,083	94,039	707	2	14,173	1,694	22,468	18·2	*93,060*	*14·1*

	Returns, 1893.								Children remaining "unaccounted for" when the Returns for the several Years were received.	
—	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	*Total Number for the Years 1888-92.*	*Average per-centage for the Years 1888-92.*
BEDFORD.										
Ampthill - - - -	383	328	—	—	33	1	21	5·7	*407*	*5·2*
Bedford - - -	1,296	528	3	—	153	21	591	47·2	*1,271*	*19·3*
Biggleswade - - -	793	251	—	—	75	3	464	58·9	*853*	*21·6*
Leighton Buzzard - -	518	43	1	—	61	—	413	79·7	*567*	*20·3*
Luton - - -	1,317	39	6	—	219	1	1,052	80·0	*4,641*	*52·9*
Woburn - - -	220	141	1	—	21	1	56	25·9	*126*	*10·9*
	4,527	1,330	11	—	562	27	2,597	58·0	*7,565*	*32·3*
BERKS.										
Abingdon - -	535	479	—	—	38	2	16	3·4	*86*	*3·1*
Bradfield - - -	488	440	—	—	34	1	13	2·9	*78*	*3·1*
Cookham - - -	589	486	4	—	39	13	47	10·2	*211*	*7·5*
Easthampstead - -	365	344	—	—	21	—	—	0·0	*50*	*2·9*
Faringdon - - -	399	311	1	—	39	17	31	12·0	*163*	*9·1*
Hungerford - - -	490	445	—	—	34	5	6	2·2	*34*	*1·5*
Newbury - - -	565	473	3	—	50	17	22	6·9	*197*	*6·8*
Reading - - -	1,870	1,389	10	—	192	79	200	14·9	*1,116*	*12·5*
Wallingford - - -	365	332	1	—	27	4	1	1·4	*49*	*2·7*
Wantage - - -	490	429	—	—	29	7	25	6·5	*77*	*3·2*
Windsor - - -	964	820	3	—	69	6	66	7·5	*330*	*7·3*
Wokingham - - -	414	357	—	—	26	2	29	7·5	*160*	*6·7*
	7,534	6,305	22	—	596	153	456	8·1	*2,551*	*6·9*
BUCKS.										
Amersham - - -	601	398	1	—	48	4	150	25·6	*133*	*4·4*
Aylesbury - - -	679	598	1	—	60	10	10	2·9	*179*	*4·9*
Buckingham - -	315	258	6	—	22	8	21	9·2	*88*	*6·0*
Eton - - - -	806	703	1	—	54	10	38	6·0	*131*	*3·4*
Newport Pagnell - -	785	579	2	—	92	13	99	14·3	*213*	*5·4*
Winslow - - -	217	100	—	—	20	1	96	44·7	*127*	*11·9*
Wycombe - - -	1,322	787	—	—	116	15	404	31·7	*377*	*5·7*
	4,725	3,423	11	—	412	61	818	18·6	*1,248*	*5·3*
CAMBRIDGE.										
Cambridge - - -	976	760	9	—	121	22	64	8·8	*318*	*6·5*
Caxton and Arrington -	242	219	—	—	19	2	2	1·7	*29*	*2·3*
Chesterton - - -	787	679	—	—	64	3	39	5·3	*144*	*3·5*
Ely - - - -	566	492	—	—	36	6	32	6·7	*178*	*6·2*
Linton - - -	342	299	—	—	27	3	13	4·7	*67*	*3·7*
Newmarket - - -	926	724	2	—	91	107	2	11·8	*168*	*3·7*
North Witchford - -	494	444	1	—	42	1	6	1·4	*62*	*2·5*
Whittlesey - - -	185	168	—	—	12	2	3	2·7	*19*	*2·3*
Wisbech - - -	851	749	—	—	73	10	17	3·2	*327*	*7·3*
	5,369	4,534	12	—	489	156	178	6·2	*1,312*	*4·8*

	Returns, 1893.								Children remaining "unaccounted for" when the Returns for the several Years were received.	
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	*Total Number for the Years 1888–92.*	*Average Per-centage for the Years 1888–92.*
CHESHIRE.										
Birkenhead	4,495	3,805	22	1	545	22	100	2·7	*513*	*2·5*
Bucklow	1,723	1,500	12	—	146	24	41	3·8	*263*	*3·1*
Chester	1,496	1,291	11	—	149	11	34	3·0	*222*	*3·0*
Congleton	1,171	980	1	—	124	19	47	5·6	*164*	*2·9*
Macclesfield	1,566	1,302	6	—	189	18	51	4·4	*247*	*3·0*
Nantwich	2,152	1,747	14	—	233	32	126	7·3	*756*	*7·1*
Northwich	2,092	1,849	2	—	209	10	22	1·5	*105*	*1·1*
Runcorn	1,560	1,172	10	—	164	25	189	13·7	*315*	*4·4*
Stockport	4,089	2,941	24	—	603	59	462	12·5	*1,841*	*9·2*
Tarvin	462	419	—	—	41	1	1	0·4	*51*	*3·2*
Wirral	1,057	862	6	—	77	18	94	10·6	*404*	*7·8*
	21,863	17,868	108	1	2,480	239	1,167	6·4	*4,881*	4·7
CORNWALL.										
Austell, St.	906	737	1	—	87	10	71	8·9	*200*	*4·4*
Bodmin	471	398	1	—	43	13	16	6·2	*115*	*4·8*
Camelford	203	167	—	—	23	9	4	6·4	*51*	*5·4*
Columb, St., Major	369	311	—	—	37	13	8	5·7	*79*	*3·9*
Falmouth	587	87	—	—	60	4	436	75·0	*1,462*	*50·1*
Germans, St.	435	391	—	—	30	8	6	3·2	*86*	*3·6*
Helston	613	468	1	—	95	13	36	8·0	*221*	*7·0*
Launceston	388	352	—	—	20	5	11	4·1	*52*	*2·4*
Liskeard	667	552	2	—	58	6	49	8·2	*200*	*5·6*
Penzance	1,381	967	1	—	191	21	201	16·1	*669*	*9·6*
Redruth	1,486	782	—	—	253	10	441	30·3	*1,109*	*14·6*
Stratton	190	160	—	—	21	6	3	4·7	*74*	*7·6*
Truro	831	381	1	—	105	10	334	41·4	*854*	*20·3*
	8,527	5,753	7	—	1,023	128	1,616	20·5	*5,172*	*11·8*
CUMBERLAND.										
Alston-with-Garrigill	81	71	—	—	4	5	1	7·4	*46*	*4·1*
Bootle	466	364	—	—	52	22	28	10·7	*383*	*15·6*
Brampton	231	188	1	—	15	16	11	11·7	*130*	*10·4*
Carlisle	1,797	1,481	2	—	207	74	33	6·0	*377*	*4·7*
Cockermouth	2,338	1,549	1	—	285	57	446	21·5	*1,524*	*12·3*
Longtown	179	159	—	—	10	2	8	5·6	*47*	*5·1*
Penrith	640	582	4	—	57	5	12	2·7	*49*	*1·7*
Whitehaven	1,792	1,534	3	—	164	38	53	5·1	*408*	*4·7*
Wigton	647	571	—	—	57	11	8	2·9	*170*	*5·0*
	8,171	6,479	11	—	851	230	600	10·2	*3,164*	*7·6*
DERBY.										
Ashbourne	524	452	1	—	38	4	29	6·3	*131*	*4·6*
Bakewell	891	683	9	—	72	23	104	14·3	*290*	*7·1*
Belper	2,157	1,759	7	—	210	28	153	8·4	*224*	*2·2*
Chapel-en-le-Frith	675	562	—	—	50	13	50	9·3	*255*	*7·7*
Chesterfield	4,622	3,246	8	1	590	50	727	16·8	*2,872*	*14·5*
Derby	3,142	737	2	—	420	2	1,981	63·1	*3,304*	*23·6*
Glossop	701	540	—	—	99	12	50	8·8	*311*	*8·1*
Hayfield	355	298	3	—	28	3	23	7·3	*77*	*4·5*
Shardlow	1,840	1,240	6	—	156	37	392	23·3	*691*	*7·9*
	14,907	9,526	36	1	1,663	172	3,509	24·7	*8,155*	*11·9*

	Returns, 1893.								Children remaining "unaccounted for" when the Returns for the several Years were received.	
—	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	*Total Number for the Years 1886–92.*	*Average Per-centage for the Years 1886–92.*
DEVON.										
Axminster	432	377	2	—	40	5	8	3·0	*76*	*3·4*
Barnstaple	1,105	943	2	—	103	30	27	5·2	*298*	*5·2*
Bideford	589	534	—	—	39	6	10	2·7	*75*	*2·6*
Crediton	481	428	—	—	35	1	17	3·7	*78*	*3·2*
East Stonehouse	514	286	2	—	66	4	156	31·1	*302*	*11·4*
Exeter	998	698	2	—	126	60	112	17·2	*577*	*11·6*
Holsworthy	269	238	—	—	24	2	5	2·6	*22*	*2·3*
Honiton	481	436	8	—	28	5	4	1·9	*116*	*4·4*
Kingsbridge	469	418	—	—	37	2	12	3·0	*56*	*2·4*
Newton Abbot	1,834	1,623	5	—	165	12	29	2·2	*213*	*2·3*
Okehampton	446	406	—	—	20	7	13	4·5	*91*	*4·2*
Plymouth	2,596	1,801	8	—	372	17	398	16·0	*1,414*	*11·4*
Plympton St. Mary	686	571	1	—	43	1	65	9·6	*316*	*9·4*
Southmolton	408	365	—	—	26	13	4	4·2	*77*	*3·7*
Stoke Damerel	1,621	1,221	4	—	197	50	149	12·3	*1,090*	*14·0*
Tavistock	652	591	1	—	48	3	9	1·8	*106*	*2·8*
Thomas, St.	1,360	1,133	3	—	135	56	33	6·5	*484*	*7·1*
Tiverton	774	653	4	—	66	4	47	6·6	*189*	*5·0*
Torrington	348	304	1	—	26	7	10	4·9	*58*	*3·1*
Totnes	1,089	990	3	—	78	4	14	1·7	*155*	*2·8*
	17,152	14,016	46	—	1,679	289	1,122	8·2	*5,799*	*6·7*
DORSET.										
Beaminster	259	235	1	—	14	1	8	3·5	*62*	*4·3*
Blandford	340	285	2	—	22	2	29	9·1	*127*	*7·8*
Bridport	342	307	2	—	26	5	2	2·0	*57*	*3·1*
Cerne	175	161	—	—	11	2	1	1·7	*19*	*2·2*
Dorchester	459	395	—	—	37	10	17	5·9	*87*	*3·6*
Poole	871	639	4	—	78	19	131	17·2	*189*	*5·1*
Shaftesbury	292	244	1	—	22	8	17	8·6	*117*	*7·9*
Sherborne	309	259	—	—	18	4	28	10·4	*65*	*4·0*
Sturminster	252	225	—	—	16	—	11	4·4	*59*	*4·4*
Wareham and Purbeck	395	364	—	—	23	1	7	2·0	*53*	*2·3*
Weymouth	781	473	—	—	55	13	240	32·4	*1,201*	*30·3*
Wimborne and Cranborne	506	418	—	—	24	17	47	12·6	*207*	*8·3*
	4,981	4,005	10	—	346	82	538	12·4	*2,243*	*8·9*
DURHAM.										
Auckland	3,317	2,551	6	—	415	62	283	10·4	*1,441*	*8·7*
Chester-le-Street	2,113	1,687	1	—	269	38	118	7·4	*545*	*5·7*
Darlington	1,485	746	2	—	199	28	510	36·2	*1,371*	*18·9*
Durham	2,442	2,012	10	—	328	28	64	3·8	*532*	*4·2*
Easington	2,090	1,775	—	—	244	20	51	3·4	*282*	*3·0*
Gateshead	5,137	3,197	7	—	631	78	1,224	25·3	*3,610*	*15·1*
Hartlepool	2,620	2,141	10	—	297	27	145	6·6	*896*	*7·4*
Houghton-le-Spring	1,561	1,295	4	—	218	10	34	2·8	*262*	*3·4*
Lanchester	2,482	1,899	3	—	283	45	252	12·0	*715*	*6·2*
Sedgefield	717	608	1	—	85	8	15	3·2	*148*	*4·1*
South Shields	5,291	3,814	18	1	650	125	683	15·3	*4,415*	*17·1*
Stockton	2,146	1,787	5	—	216	31	107	6·4	*1,282*	*11·9*
Sunderland	5,910	4,602	15	—	715	131	447	9·8	*1,541*	*5·2*
Teesdale	621	446	2	—	70	13	90	16·6	*256*	*8·8*
Weardale	499	425	2	—	52	5	15	4·0	*70*	*2·9*
	38,431	28,985	86	1	4,672	649	4,088	12·2	*17,366*	*9·4*

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ESSEX.										
Billericay	473	404	—	—	29	18	22	8·5	*208*	*8·3*
Braintree	699	612	—	—	53	15	19	4·9	*189*	*3·6*
Chelmsford	937	792	—	—	69	23	53	8·1	*276*	*6·1*
Colchester	1,002	752	1	—	99	11	139	15·0	*559*	*11·6*
Dunmow	459	419	—	—	24	4	12	3·5	*74*	*3·4*
Epping	725	622	3	—	49	9	42	7·0	*186*	*5·4*
Halstead	481	428	—	—	31	10	12	4·6	*79*	*3·6*
Lexden and Winstree	615	549	—	—	45	9	12	3·4	*74*	*2·5*
Maldon	655	597	—	—	42	4	12	2·4	*248*	*7·1*
Ongar	267	221	1	—	29	7	9	6·0	*105*	*7·6*
Orsett	991	663	—	—	109	42	177	22·1	*687*	*13·2*
Rochford	991	707	5	—	83	5	191	19·8	*398*	*8·7*
Romford	1,795	1,376	3	—	166	37	213	13·9	*1,230*	*14·6*
Saffron Walden	492	432	—	—	35	4	21	5·1	*102*	*4·3*
Tendring	1,132	968	4	—	95	3	42	4·0	*215*	*3·8*
West Ham	14,068	9,445	67	—	1,406	362	2,788	22·4	*9,496*	*15·2*
	25,782	19,007	84	—	2,364	563	3,764	16·8	*14,004*	*11·7*
GLOUCESTER.										
Barton Regis	6,089	4,528	34	1	631	282	613	14·7	*2,066*	*7·2*
Bristol	1,542	1,186	13	—	175	18	150	10·9	*678*	*8·4*
Cheltenham	1,282	828	4	—	152	12	286	23·2	*1,428*	*22·3*
Chipping Sodbury	471	370	3	—	30	15	53	14·4	*163*	*7·4*
Cirencester	543	361	3	—	40	12	127	25·6	*335*	*12·5*
Dursley	335	211	—	—	26	4	94	29·3	*290*	*13·6*
Gloucester	1,515	38	—	—	174	—	1,303	86·0	*6,245*	*85·5*
Newent	287	216	—	—	16	9	46	19·2	*124*	*8·7*
Northleach	228	202	—	—	11	—	15	6·6	*81*	*7·2*
Stow-on-the-Wold	232	183	1	—	22	10	16	11·2	*94*	*7·5*
Stroud	1,101	688	1	1	103	22	286	28·0	*454*	*8·2*
Tetbury	147	81	1	—	15	13	37	34·0	*142*	*18·8*
Tewkesbury	384	90	1	—	44	—	249	64·8	*483*	*26·1*
Thornbury	478	416	—	—	25	13	24	7·7	*79*	*3·3*
Westbury-on-Severn	798	214	—	—	64	16	504	65·2	*1,173*	*29·1*
Wheatenhurst	182	29	—	—	15	8	130	75·8	*347*	*38·1*
Winchcomb	263	213	—	—	18	14	18	12·2	*74*	*6·0*
	15,877	9,854	61	2	1,561	448	3,951	27·7	*14,180*	*18·3*
HEREFORD.										
Bromyard	301	249	—	—	25	12	15	9·0	*111*	*7·8*
Dore	210	169	—	—	21	6	14	9·5	*76*	*7·3*
Hereford	927	756	—	—	92	15	64	8·5	*271*	*5·9*
Kington	313	257	1	—	29	8	18	8·3	*69*	*4·6*
Ledbury	347	301	—	—	30	6	10	4·6	*94*	*5·6*
Leominster	357	313	1	—	29	2	12	3·9	*83*	*4·9*
Ross	469	363	—	—	54	11	41	11·1	*115*	*5·3*
Weobley	205	176	—	—	10	11	8	9·3	*63*	*6·3*
	3,129	2,584	2	—	290	71	182	8·1	*882*	*5·8*

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HERTS.										
Albans, St.	717	252	—	—	69	12	384	55·2	*1,185*	*20·7*
Barnet	1,258	994	8	—	93	31	132	13·0	*982*	*16·0*
Berkhampstead	428	377	1	—	32	1	17	4·2	*66*	*3·0*
Bishop's Stortford	537	472	1	—	39	4	21	4·7	*104*	*3·7*
Buntingford	142	129	—	—	9	—	4	2·8	*45*	*6·1*
Hatfield	202	176	—	—	17	—	9	4·5	*58*	*5·9*
Hemel Hempstead	439	312	1	1	48	1	76	17·5	*210*	*10·0*
Hertford	438	375	—	—	35	—	28	6·4	*121*	*5·6*
Hitchin	777	681	3	—	59	1	33	4·4	*92*	*2·4*
Royston	473	424	—	—	34	—	15	3·2	*74*	*3·3*
Ware	545	482	—	—	40	5	18	4·2	*96*	*3·7*
Watford	1,134	692	10	—	75	6	351	31·5	*644*	*12·6*
Welwyn	60	55	—	—	2	—	3	5·0	*8*	*2·7*
	7,150	5,421	24	1	552	61	1,091	16·1	*3,685*	*10·5*
HUNTINGDON.										
Huntingdon	529	474	—	—	45	2	8	1·9	*80*	*3·0*
Ives, St.	391	347	3	—	30	2	9	2·8	*62*	*2·9*
Neots, St.	383	326	—	—	40	1	16	4·4	*75*	*3·7*
	1,303	1,147	3	—	115	5	33	2·9	*217*	*3·2*
KENT (Extra-Metropolitan).										
Ashford, East	354	317	—	—	18	5	14	5·4	*76*	*3·8*
Ashford, West	518	435	5	—	38	17	23	7·7	*248*	*9·1*
Blean	566	491	2	—	42	8	23	5·5	*148*	*5·3*
Bridge	317	275	—	—	28	4	10	4·4	*120*	*7·2*
Bromley	1,877	1,321	9	—	255	59	233	15·6	*704*	*7·5*
Canterbury	468	396	2	—	49	4	17	4·5	*116*	*4·8*
Cranbrook	366	315	3	—	28	1	19	5·5	*74*	*4·5*
Dartford	2,155	1,751	8	1	185	22	188	9·7	*1,181*	*11·4*
Dover	1,086	781	2	—	115	17	171	17·3	*898*	*16·4*
Eastry	716	686	2	—	57	8	13	2·9	*98*	*2·6*
Elham	1,053	893	2	—	87	32	39	6·7	*378*	*7·0*
Faversham	762	704	2	—	43	2	11	1·7	*86*	*2·1*
Gravesend and Milton	629	481	15	—	63	—	70	11·1	*523*	*16·0*
Hollingbourn	388	335	—	—	36	3	14	4·4	*68*	*3·8*
Hoo	137	122	—	—	10	1	4	3·6	*38*	*5·6*
Maidstone	1,264	756	4	8	100	19	377	31·3	*1,051*	*15·8*
Malling	806	697	1	—	69	11	28	4·8	*224*	*5·2*
Medway	2,307	1,969	2	—	210	60	66	5·5	*834*	*7·4*
Milton	894	693	5	—	56	33	37	8·5	*263*	*6·0*
Romney Marsh	196	173	1	—	19	2	1	1·5	*18*	*1·9*
Sevenoaks	784	668	2	—	54	17	43	7·7	*239*	*5·9*
Sheppey	508	452	2	—	42	5	7	2·4	*71*	*2·6*
Strood	1,225	1,057	7	—	105	4	52	4·6	*318*	*5·1*
Tenterden	292	260	—	—	21	—	11	3·8	*51*	*2·8*
Thanet, Isle of	1,384	1,204	6	—	125	17	32	3·5	*281*	*4·0*
Tonbridge	1,523	773	7	—	139	37	567	39·7	*1,685*	*22·8*
	22,505	17,955	89	9	1,994	388	2,070	10·9	*9,779*	*5·6*

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LANCASTER.										
Ashton-under-Lyne	4,990	1,932	12	—	863	55	2,128	43·7	*4,971*	*19·8*
Barrow-in-Furness	1,690	1,487	3	—	144	12	44	3·3	*249*	*2·8*
Barton-upon-Irwell	2,717	1,908	14	—	316	230	249	17·6	*844*	*6·4*
Blackburn	638	4,896	47	—	871	77	496	9·0	*2,965*	*6·7*
Bolton	7,700	6,473	19	—	864	13	331	4·5	*742*	*2·0*
Burnley	5,793	2,529	63	—	824	92	2,285	41·0	*7,436*	*25·7*
Bury	3,741	1,232	10	—	538	13	1,948	52·4	*3,085*	*15·5*
Chorley	1,916	1,481	6	—	273	37	119	8·1	*506*	*5·7*
Chorlton	9,523	7,279	18	—	1,288	225	713	9·8	*4,109*	*8·9*
Clitheroe	611	458	1	—	68	22	62	13·7	*293*	*9·2*
Fylde, The	1,643	1,277	24	—	202	59	81	8·5	*445*	*5·9*
Garstang	310	262	—	—	33	7	8	4·8	*65*	*4·2*
Haslingden	2,910	2,104	6	—	346	42	412	15·6	*1,259*	*8·5*
Lancaster	1,622	1,328	4	—	189	30	71	6·2	*313*	*4·2*
Leigh	2,977	2,373	1	—	347	—	256	8·6	*740*	*5·4*
Liverpool	5,104	4,129	9	—	731	12	223	4·6	*1,099*	*4·3*
Lunesdale	183	169	2	—	5	2	5	3·8	*27*	*2·8*
Manchester	5,095	4,374	7	—	596	23	95	2·3	*992*	*3·9*
Oldham	6,039	316	1	—	1,017	1	4,704	77·9	*22,434*	*72·7*
Ormskirk	2,856	2,364	35	1	317	39	100	4·9	*740*	*5·5*
Prescot	5,390	4,270	20	—	661	104	335	8·1	*1,714*	*6·5*
Preston	4,841	3,332	15	3	836	71	584	13·5	*2,551*	*10·6*
Prestwich	4,938	3,663	18	—	513	79	665	15·1	*2,679*	*10·9*
Rochdale	3,118	1,414	6	—	403	16	1,279	41·5	*1,276*	*8·2*
Salford	7,290	5,079	34	—	1,094	214	869	14·9	*4,487*	*12·2*
Todmorden	955	311	3	—	114	3	524	55·2	*754*	*15·9*
Toxteth Park	4,403	3,248	21	—	563	66	505	13·0	*3,078*	*14·7*
Ulverston	1,217	1,052	6	—	103	29	27	4·6	*312*	*4·7*
Warrington	3,335	2,809	27	1	368	15	115	3·9	*777*	*4·9*
West Derby	15,831	12,771	52	—	1,855	165	988	7·3	*4,092*	*5·5*
Wigan	7,390	5,519	21	—	990	253	707	13·0	*2,033*	*6·1*
	132,515	91,839	505	5	17,232	2,006	20,928	17·3	*76,029*	*11·7*
LEICESTER.										
Ashby-de-la-Zouch	1,324	528	3	—	177	13	603	46·5	*1,125*	*18·2*
Barrow-on-Soar	676	29	—	—	122	—	525	77·7	*3,128*	*62·1*
Billesdon	141	119	—	—	7	1	14	10·6	*660*	*38·3*
Blaby	741	47	—	—	92	—	602	81·2	*2,574*	*48·2*
Hinckley	771	183	1	—	101	1	485	63·0	*1,365*	*38·3*
Leicester	6,010	119	3	—	1,100	—	4,788	79·7	*19,703*	*79·2*
Loughborough	922	89	3	—	137	—	693	75·2	*2,257*	*46·8*
Lutterworth	289	216	—	—	28	3	42	15·6	*88*	*6·3*
Market Bosworth	537	411	2	—	41	9	74	15·5	*212*	*8·2*
Market Harborough	407	159	—	—	39	11	198	51·4	*283*	*13·2*
Melton Mowbray	639	153	1	1	83	1	400	62·8	*723*	*23·9*
	12,457	2,053	13	1	1,927	39	8,424	67·9	*32,118*	*52·9*
LINCOLN.										
Boston	1,035	772	2	—	100	109	52	15·6	*372*	*7·2*
Bourne	527	414	2	—	45	4	62	12·5	*260*	*9·8*
Caistor	443	369	2	—	40	14	18	7·2	*239*	*5·5*
Gainsborough	1,046	414	1	—	135	3	493	47·4	*544*	*10·7*
Glanford Brigg	1,291	1,070	2	—	142	19	58	6·0	*225*	*3·6*
Grantham	937	788	29	—	88	10	22	3·4	*186*	*3·9*
Grimsby	2,304	1,646	6	—	381	93	178	11·8	*771*	*9·2*

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LINCOLN—*cont.*										
Holbeach	448	249	2	—	40	2	155	35·0	*256*	*10·2*
Horncastle	513	369	—	—	45	7	92	19·3	*161*	*6·3*
Lincoln	1,917	1,510	11	—	244	50	102	7·9	*774*	*8·4*
Louth	721	590	2	—	65	24	40	8·9	*279*	*6·9*
Sleaford	679	504	1	—	65	3	106	16·1	*267*	*8·3*
Spalding	557	312	1	—	45	2	197	35·7	*278*	*9·5*
Spilsby	591	483	2	—	76	8	22	5·1	*161*	*5·0*
Stamford	434	363	3	—	41	4	23	6·2	*135*	*6·2*
	13,443	9,853	66	—	1,552	352	1,620	14·7	*4,903*	*7·4*
MIDDLESEX (Extra-Metropolitan).										
Brentford	4,063	3,230	53	—	460	14	306	7·9	*1,605*	*8·4*
Edmonton	7,836	5,825	44	—	691	187	1,089	16·3	*4,682*	*12·7*
Hendon	3,313	2,419	36	—	298	60	500	16·9	*2,015*	*12·7*
Staines	778	609	2	—	83	7	77	10·8	*554*	*15·0*
Uxbridge	848	723	3	—	64	6	52	6·8	*214*	*4·9*
	16,838	12,806	138	—	1,596	274	2,024	13·6	*9,070*	*11·5*
MONMOUTH.										
Abergavenny	784	655	—	—	78	35	16	6·5	*159*	*4·3*
Bedwellty	2,672	1,973	1	—	287	154	307	17·3	*1,009*	*8·4*
Chepstow	574	440	1	—	45	12	67	13·8	*199*	*7·0*
Monmouth	845	624	—	—	81	29	111	16·6	*341*	*8·5*
Newport	3,721	3,076	16	—	407	58	164	6·0	*926*	*5·3*
Pontypool	1,524	1,139	2	—	141	56	186	15·7	*664*	*9·5*
	10,120	7,866	20	—	1,039	344	851	11·8	*3,298*	*7·0*
NORFOLK.										
Aylsham	494	412	2	—	50	13	17	6·1	*81*	*3·2*
Blofield	322	260	—	—	35	8	19	8·4	*79*	*4·6*
Depwade	665	558	—	—	62	10	35	6·8	*222*	*6·8*
Docking	456	283	2	—	21	3	147	32·9	*89*	*4·0*
Downham	540	466	2	—	46	1	25	4·8	*88*	*3·4*
Erpingham	529	433	—	—	56	10	30	7·6	*178*	*6·8*
Faith, St.	344	215	—	—	38	4	87	26·5	*228*	*13·3*
Flegg, East and West	318	267	—	—	38	8	5	4·1	*55*	*3·4*
Forehoe	313	245	—	—	22	2	44	14·7	*131*	*8·1*
Freebridge Lynn	315	283	—	—	17	2	13	4·8	*126*	*7·3*
Guiltcross	270	238	—	—	14	1	17	6·7	*59*	*4·2*
Henstead	274	208	—	—	19	—	47	17·2	*144*	*9·6*
King's Lynn	574	38	1	—	90	—	445	77·5	*1,118*	*42·2*
Loddon and Clavering	354	295	1	—	30	2	26	7·9	*84*	*4·6*
Mitford and Launditch	705	595	1	—	68	9	32	5·8	*168*	*4·6*
Norwich	3,212	619	1	—	530	—	2,062	64·2	*4,334*	*27·2*
Smallburgh	493	379	1	—	57	8	48	11·4	*182*	*7·4*
Swaffham	355	280	—	—	25	—	50	14·1	*215*	*12·8*
Thetford	473	411	—	—	48	5	9	3·0	*57*	*2·4*
Walsingham	521	426	2	—	62	11	20	6·0	*169*	*6·1*
Wayland	282	241	—	—	26	5	8	4·6	*59*	*4·0*
Yarmouth, Great	1,391	1,051	6	—	152	43	139	13·1	*845*	*12·0*
	13,200	8,203	19	—	1,508	145	3,325	26·3	*8,751*	*13·2*

—	Returns, 1893. Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	Children remaining "unaccounted for" when the Returns for the several Years were received. Total Number for the Years 1888–92.	Average Per-centage for the Years 1888–92.
NORTHAMPTON.										
Brackley - - -	308	60	1	—	17	—	230	74·7	*417*	*27·0*
Brixworth - - -	307	211	—	—	22	2	72	24·1	*208*	*13·0*
Daventry - - -	472	379	—	—	36	10	47	12·1	*148*	*6·1*
Hardingstone - -	279	200	—	—	29	1	49	17·9	*211*	*13·6*
Kettering - - -	1,228	32	—	—	197	—	999	81·4	*3,376*	*59·7*
Northampton - -	2,516	140	—	—	364	14	1,998	80·0	*8,525*	*67·5*
Oundle - - -	308	261	—	—	25	3	19	7·1	*86*	*5·2*
Peterborough - -	1,368	1,170	2	—	122	12	62	5·4	*384*	*8·0*
Potterspury - - -	335	261	—	—	20	13	41	16·1	*168*	*9·5*
Thrapston - - -	392	62	—	—	43	—	287	73·2	*1,085*	*51·0*
Towcester - - -	310	234	—	—	25	14	37	16·5	*161*	*10·0*
Wellingborough - -	1,496	29	—	—	206	—	1,261	84·3	*4,212*	*59·9*
	9,319	3,039	3	—	1,106	69	5,102	55·5	*19,060*	*41·1*
NORTHUMBERLAND.										
Alnwick - - -	619	517	—	—	67	7	28	5·7	*208*	*6·5*
Belford - - -	125	112	—	—	8	3	2	4·0	*8*	*1·2*
Bellingham - - -	114	104	—	—	5	—	5	4·4	*17*	*2·8*
Berwick-upon-Tweed -	552	485	—	—	48	11	8	3·4	*86*	*3·2*
Castle Ward - - -	773	628	5	—	87	2	51	6·9	*233*	*6·4*
Glendale - - -	210	186	—	—	12	5	7	5·7	*31*	*2·7*
Haltwhistle - - -	198	123	—	—	18	5	52	28·8	*129*	*12·3*
Hexham - - -	974	818	—	—	68	14	74	9·0	*331*	*7·5*
Morpeth - - -	1,751	1,051	1	—	308	6	385	22·3	*421*	*5·9*
Newcastle-on-Tyne -	7,031	5,624	35	—	787	146	439	8·3	*2,516*	*7·3*
Rothbury - - -	150	138	—	—	12	—	—	—	*11*	*1·5*
Tynemouth - -	5,128	3,819	21	—	657	292	339	12·3	*2,497*	*10·9*
	17,625	13,605	62	—	2,077	491	1,390	10·7	*6,488*	*7·9*
NOTTINGHAM.										
Basford - - -	6,149	4,481	17	—	705	141	805	15·4	*2,752*	*9·7*
Bingham - - -	344	290	1	—	21	16	16	9·3	*208*	*11·2*
East Retford - -	690	593	4	—	52	7	34	5·9	*92*	*2·8*
Mansfield - - -	2.425	1,706	2	—	264	32	361	16·2	*1,130*	*11·1*
Newark - - -	808	705	2	—	66	5	30	4·3	*151*	*3·6*
Nottingham - - -	5,318	3,502	22	—	790	25	979	18·9	*4,850*	*18·5*
Southwell - - -	493	427	—	—	29	11	26	7·5	*128*	*5·2*
Worksop - - -	1,135	979	4	—	108	11	33	3·9	*169*	*3·1*
	17,362	12,743	52	—	2,035	248	2,284	14·6	*9,481*	*11·6*
OXFORD.										
Banbury - - -	805	158	—	—	103	1	543	67·6	*1,931*	*47·9*
Bicester - - -	364	308	—	—	28	4	24	7·7	*117*	*6·0*
Chipping Norton - -	459	317	—	—	35	25	82	23·3	*268*	*10·3*
Headington - - -	1,017	906	4	—	86	8	13	2·1	*84*	*1·7*
Henley - - -	670	520	1	—	59	18	72	13·4	*232*	*7·4*
Oxford - - -	614	509	6	—	69	7	23	4·9	*164*	*5·3*
Thame - - -	336	290	—	—	21	3	22	7·4	*107*	*5·7*
Witney - - -	617	543	—	—	47	8	19	4·4	*78*	*2·6*
Woodstock - -	367	303	1	—	37	3	23	7·1	*132*	*6·9*
	5,249	3,854	12	—	485	77	821	17·1	*3,113*	*11·8*

	Returns, 1893.								Children remaining "unaccounted for" when the Returns for the several Years were received.	
—	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	*Total Number for the Years 1888–92.*	*Average Percentage for the Years 1888–92.*
RUTLAND.										
Oakham - - -	261	229	—	—	19	10	3	5·0	*32*	*2·3*
Uppingham - - -	275	235	1	—	25	—	14	5·1	*63*	4·7
	536	464	1	—	44	10	17	5·0	*95*	*3·5*
SALOP.										
Atcham - - -	1,243	1,033	4	—	109	23	74	7·8	*446*	*7·1*
Bridgnorth - - -	396	334	—	—	37	3	22	6·3	*128*	*7·1*
Church Stretton - -	134	114	—	—	15	—	5	3·7	*46*	*2·3*
Cleobury Mortimer -	234	205	1	—	15	8	5	5·6	*58*	*3·7*
Clun - - -	238	145	—	—	22	9	62	29·8	*164*	*12·6*
Drayton - - -	397	342	1	—	46	2	6	2·0	*32*	*1·7*
Ellesmere - - -	369	332	2	—	24	1	10	3·0	*40*	*2·3*
Ludlow - - -	466	360	1	—	66	9	30	8·4	*154*	*6·5*
Madeley - - -	682	600	—	—	56	6	20	3·8	*86*	*2·6*
Newport - - -	399	348	—	—	36	5	10	3·8	*71*	*3·6*
Oswestry - - -	828	751	2	—	52	1	22	2·8	*98*	*2·5*
Shifnal - - -	294	254	—	—	19	1	20	7·1	*105*	*6·2*
Wellington - - -	717	552	2	—	81	2	80	11·4	*153*	*4·2*
Wem - - -	286	257	1	—	23	4	1	1·7	*34*	*2·6*
Whitchurch - - -	329	303	—	—	20	2	4	1·8	*44*	*2·7*
	7,012	5,930	14	—	621	76	371	6·4	*1,627*	4·7
SOMERSET.										
Axbridge - - -	1,011	518	3	—	82	14	394	40·4	*1,349*	*25·6*
Bath - - -	1,752	1,171	3	—	206	117	255	21·2	*2,291*	*25·1*
Bedminster - - -	2,740	1,825	10	1	347	82	475	20·3	*2,094*	*15·9*
Bridgwater - - -	911	693	—	—	84	12	122	14·7	*482*	*10·1*
Chard - - -	712	619	—	—	53	13	27	5·6	*208*	*5·8*
Clutton - - -	839	731	—	—	54	7	47	6·4	*181*	*4·5*
Dulverton - - -	139	122	1	—	14	2	—	1·4	*16*	*2·5*
Frome - - -	600	531	—	—	33	—	36	6·0	*160*	*5·2*
Keynsham - - -	1,104	756	6	—	91	4	247	22·7	*686*	*14·2*
Langport - - -	412	363	—	—	25	4	20	5·7	*97*	*4·8*
Shepton Mallet - -	442	377	1	—	37	2	25	6·1	*163*	*7·2*
Taunton - - -	1,063	915	6	—	91	8	43	4·8	*358*	*7·0*
Wellington - - -	502	410	—	—	37	15	40	11·0	*192*	*7·8*
Wells - - -	640	517	4	—	50	14	55	10·8	*185*	*5·5*
Williton - - -	436	389	—	—	29	11	7	4·1	*52*	*2·4*
Wincanton - - -	485	410	5	—	37	9	24	6·8	*138*	*5·5*
Yeovil - - -	776	675	1	—	56	8	36	5·7	*275*	*7·2*
	14,564	11,022	40	1	1,326	322	1,853	14·9	*8,834*	*12·3*
SOUTHAMPTON.										
Alresford - - -	171	159	—	—	8	1	3	2·3	*30*	*3·3*
Alton - - -	389	349	4	—	23	3	10	3·3	*64*	*3·2*
Alverstoke - - -	776	690	4	—	65	1	16	2·2	*89*	*2·2*
Andover - - -	431	344	2	—	31	8	46	12·5	*188*	*8·6*
Basingstoke - - -	572	285	—	—	34	—	253	44·2	*766*	*27·5*
Catherington - -	79	57	—	—	5	—	17	21·5	*28*	*7·2*
Christchurch - -	1,400	934	13	—	123	26	304	23·6	*1,077*	*17·0*
Droxford - - -	276	241	3	—	17	1	14	5·4	*67*	*4·5*
Fareham - - -	484	435	—	—	29	1	19	4·1	*82*	*3·1*
Fordingbridge - -	182	163	—	—	12	—	7	3·8	*32*	*3·6*

—	Returns, 1893.								Children remaining "unaccounted for" when the Returns for the several Years were received.	
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SOUTHAMPTON—*cont.*										
Hartley Wintney	649	526	1	—	56	12	54	10·2	*256*	*8·1*
Havant	258	223	—	—	20	—	15	5·8	*48*	*3·7*
Hursley	74	68	—	—	4	—	2	2·7	*18*	*4·8*
Kingsclere	234	216	—	—	15	1	2	1·3	*24*	*2·0*
Lymington	348	300	1	—	27	3	17	5·7	*127*	*7·2*
New Forest	399	347	—	—	20	5	27	8·0	*112*	*6·1*
Petersfield	291	249	1	—	16	3	22	8·6	*98*	*6·2*
Portsea Island	4,706	4,034	37	—	483	30	122	3·2	*672*	*2·8*
Ringwood	169	157	—	—	12	—	—	—	*9*	*1·2*
Romsey	277	254	—	—	17	1	5	2·2	*55*	*3·6*
Southampton	1,701	1,393	17	—	178	27	86	6·6	*876*	*10·5*
South Stoneham	1,599	1,270	13	—	140	31	145	11·0	*587*	*8·2*
Stockbridge	186	154	1	—	15	4	12	8·6	*65*	*7·8*
Whitchurch	227	194	1	—	16	8	8	7·0	*58*	*6·0*
Wight, Isle of	1,931	1,641	5	—	120	74	91	8·6	*615*	*6·6*
Winchester, New	810	683	3	—	82	14	28	5·2	*173*	*4·4*
	18,619	15,366	106	—	1,568	254	1,325	8·5	*6,240*	*6·7*
STAFFORD.										
Burton-on-Trent	2,886	1,749	4	—	340	33	760	27·5	*1,855*	*13·4*
Cannock	1,563	1,201	1	—	187	3	171	11·1	*480*	*6·8*
Cheadle	771	630	1	—	76	7	57	8·3	*218*	*5·7*
Leek	1,150	953	1	—	112	32	52	7·3	*288*	*5·3*
Lichfield	1,361	1,163	11	—	141	13	33	3·4	*128*	*2·0*
Newcastle-under-Lyme	1,420	1,235	2	—	166	2	15	1·2	*159*	*2·4*
Seisdon	463	396	—	—	33	4	30	7·3	*102*	*4·4*
Stafford	859	703	9	—	82	21	44	7·6	*269*	*6·3*
Stoke-on-Trent	4,936	3,772	8	—	679	52	425	9·7	*1,662*	*7·4*
Stone	948	780	1	—	110	22	35	6·0	*240*	*4·3*
Tamworth	742	552	1	—	86	17	86	13·9	*269*	*7·5*
Uttoxeter	444	382	1	—	32	5	24	6·5	*58*	*2·6*
Walsall	3,921	2,274	9	—	646	46	946	25·3	*3,048*	*16·4*
West Bromwich	4,959	3,324	33	1	639	181	781	19·4	*1,536*	*6·3*
Wolstanton and Burslem	3,364	2,741	2	—	419	15	187	6·0	*719*	*4·6*
Wolverhampton	5,121	3,301	29	—	802	95	894	19·3	*2,915*	*12·0*
	34,908	25,156	113	1	4,550	548	4,540	14·6	*13,865*	*8·4*
SUFFOLK.										
Blything	707	596	—	—	65	2	44	6·5	*220*	*6·0*
Bosmere and Claydon	426	355	—	—	38	12	21	7·7	*191*	*8·5*
Bury St. Edmunds	393	330	—	—	39	16	8	6·1	*129*	*5·4*
Cosford	505	452	—	—	39	3	11	2·8	*89*	*3·7*
Hartismere	402	352	—	—	31	4	15	4·7	*92*	*4·3*
Hoxne	327	279	1	—	32	5	10	4·6	*67*	*4·0*
Ipswich	1,712	895	15	—	253	64	485	32·1	*2,096*	*24·4*
Mildenhall	227	201	—	—	24	2	—	0·9	*21*	*1·7*
Mutford and Lothingland	1,203	1,010	3	—	127	14	49	5·2	*203*	*3·0*
Plomesgate	548	450	1	—	54	7	36	7·8	*129*	*4·7*
Risbridge	500	447	—	—	44	—	9	1·8	*67*	*2·6*
Samford	383	336	2	—	35	—	10	2·6	*63*	*3·7*
Stow	568	514	—	—	39	5	10	2·6	*77*	*2·7*
Sudbury	796	664	1	—	70	12	49	7·7	*261*	*6·5*
Thingoe	481	434	—	—	31	2	14	3·3	*79*	*3·7*
Wangford	423	381	1	—	33	3	5	1·9	*62*	*2·8*
Woodbridge	672	573	—	—	46	13	40	7·9	*185*	*5·8*
	10,273	8,269	24	—	1,000	164	816	9·5	*4,023*	*7·7*

—	Returns, 1898.								Children remaining "unaccounted for" when the Returns for the several Years were received.	
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	*Total Number for the Years 1888–98.*	*Average Percentage for the Years 1888–98.*
SURREY (EXTRA-METROPOLITAN).										
Chertsey - - -	963	693	—	—	64	26	80	12·3	*580*	*12·5*
Croydon - - -	4,093	2,633	6	—	408	119	927	25·6	*8,585*	*17·7*
Dorking - - -	400	336	1	—	29	6	28	8·5	*176*	*8·6*
Epsom - - -	1,161	868	1	—	103	15	174	16·3	*774*	*13·3*
Farnham - - -	1,496	1,228	2	—	120	10	136	9·8	*479*	*6·6*
Godstone - - -	431	369	—	—	23	5	34	9·0	*149*	*6·7*
Guildford - - -	1,436	1,121	8	—	116	63	128	13·3	*588*	*8·7*
Hambledon - - -	487	441	1	—	27	8	10	3·7	*96*	*3·7*
Kingston - - -	2,891	2,279	30	—	260	90	232	11·1	*2,011*	*14·4*
Reigate - - -	909	736	2	—	52	45	74	13·1	*337*	*7·7*
Richmond - - -	1,046	933	5	—	85	1	22	2·2	*184*	*3·5*
	15,213	11,637	56	—	1,287	388	1,845	14·7	*8,849*	*11·9*
SUSSEX.										
Battle - - -	486	355	—	—	41	13	77	18·5	*349*	*14·7*
Brighton - - -	2,644	2,154	10	—	291	58	131	7·1	*876*	*6·7*
Chailey - - -	226	175	—	—	13	2	36	16·8	*146*	*12·5*
Chichester - - -	173	150	—	—	20	—	3	1·7	*39*	*3·4*
Cuckfield - - -	622	519	2	—	40	12	49	9·8	*204*	*7·0*
Eastbourne - - -	1,062	239	1	—	108	13	701	67·2	*2,942*	*58·4*
East Grinstead - -	518	324	—	—	31	17	146	31·5	*327*	*12·3*
East Preston - -	816	699	1	—	63	15	38	6·5	*180*	*4·8*
Hailsham - - -	414	342	—	—	27	7	38	10·9	*209*	*10·1*
Hastings - - -	1,418	985	10	—	137	46	240	20·2	*1,062*	*15·0*
Horsham - - -	617	500	5	—	48	1	63	10·4	*210*	*6·4*
Lewes - - -	278	140	—	—	25	2	111	40·6	*409*	*26·8*
Midhurst - - -	393	354	1	—	27	4	7	2·8	*59*	*3·2*
Newhaven - - -	294	258	—	—	18	1	17	6·1	*198*	*9·4*
Petworth - - -	249	223	1	—	17	—	8	3·2	*30*	*2·5*
Rye - - -	333	282	1	—	33	5	12	5·1	*84*	*5·4*
Steyning - - -	1,548	1,342	12	—	127	10	57	4·3	*381*	*5·3*
Thakeham - - -	207	184	—	—	18	—	5	2·4	*28*	*2·6*
Ticehurst - - -	439	322	—	—	43	7	67	16·9	*210*	*9·6*
Uckfield - - -	581	340	—	—	36	1	204	35·3	*527*	*17·7*
Westbourne - - -	183	150	1	—	16	2	14	8·7	*44*	*4·4*
West Firle - - -	79	53	—	—	4	4	18	27·8	*58*	*18·4*
Westhampnett - -	544	465	—	—	54	5	20	4·6	*121*	*4·4*
	14,124	10,555	45	—	1,237	225	2,062	16·2	*8,616*	*12·4*
WARWICK.										
Alcester - - -	561	469	—	—	58	5	29	6·1	*140*	*4·9*
Aston - - -	9,176	6,726	42	4	1,290	134	980	12·1	*4,817*	*11·1*
Atherstone - - -	579	388	2	—	82	1	106	18·5	*202*	*7·4*
Birmingham - - -	8,061	6,385	33	5	1,111	25	502	6·5	*2,670*	*6·5*
Coventry - - -	1,632	150	—	2	247	—	1,233	75·6	*2,561*	*32·3*
Foleshill - - -	700	351	—	—	73	1	275	39·4	*447*	*13·9*
Meriden - - -	272	222	—	—	12	2	36	14·0	*88*	*6·9*
Nuneaton - - -	734	128	—	—	104	—	502	68·4	*787*	*26·6*
Rugby - - -	769	619	1	—	61	47	41	11·4	*179*	*4·8*
Solihull - - -	880	683	3	—	83	9	102	12·6	*363*	*9·6*
Southam - - -	307	265	—	—	23	3	16	6·2	*83*	*5·7*
Stratford-upon-Avon -	584	504	1	—	34	1	44	7·7	*143*	*5·1*
Warwick - - -	1,270	1,088	8	—	125	25	74	7·8	*401*	*6·1*
	25,525	17,928	90	11	3,303	253	3,940	16·4	*12,881*	*10·4*

	Returns, 1893.								Children remaining "unaccounted for" when the Returns for the several Years were received.	
—	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	*Total Number for the Years 1888–92.*	*Average Percentage for the Years 1888–92.*
WESTMORLAND.										
East Ward - - -	377	321	3	—	34	6	13	5·0	*45*	*2·4*
Kendal - - -	1,186	1,062	2	—	93	16	13	2·4	*174*	*2·9*
West Ward - - -	203	180	—	—	19	—	4	2·0	*58*	*5·8*
	1,766	1,563	5	—	146	22	30	2·9	*267*	*3·0*
WILTS.										
Amesbury - - -	163	144	—	—	12	1	6	4·3	*90*	*2·3*
Bradford - - -	279	240	—	—	18	3	18	7·5	*41*	*2·8*
Calne - - -	223	155	—	—	18	—	50	22·4	*96*	*9·3*
Chippenham - -	592	475	—	—	38	43	36	13·3	*160*	*5·3*
Cricklade and Wootton Bassett.	382	293	—	—	44	12	33	11·8	*105*	*5·9*
Devizes - - -	497	394	—	—	23	15	65	16·1	*207*	*8·0*
Highworth and Swindon -	1,727	768	4	—	154	89	712	46·4	*1,372*	*17·5*
Malmesbury - - -	346	245	1	—	32	12	56	19·7	*214*	*12·4*
Marlborough - -	221	206	1	—	8	1	5	2·7	*23*	*2·0*
Melksham - - -	433	319	1	—	37	—	76	17·6	*79*	*3·3*
Mere - - - -	165	151	—	—	8	—	6	3·6	*30*	*3·5*
Pewsey - - -	312	288	—	—	17	1	6	2·2	*44*	*2·7*
Salisbury - - -	733	642	4	—	49	9	29	5·2	*241*	*6·6*
Tisbury - - -	215	185	—	—	10	10	10	9·3	*90*	*7·8*
Warminster - - -	344	267	—	—	14	6	57	18·3	*171*	*10·3*
Westbury and Whorwellsdown.	273	239	2	—	22	4	6	3·7	*28*	*1·7*
Wilton - - -	250	225	—	—	17	4	4	3·2	*48*	*3·6*
	7,155	5,236	13	—	521	210	1,175	19·4	*2,964*	*8·3*
WORCESTER.										
Bromsgrove - - -	1,038	835	7	—	98	13	85	9·4	*283*	*5·6*
Droitwich - - -	519	449	—	—	43	9	18	5·2	*87*	*3·3*
Dudley - - -	5,482	4,517	22	—	642	52	249	5·5	*851*	*3·1*
Evesham - - -	474	355	1	—	34	4	80	17·7	*160*	*7·0*
Kidderminster - -	1,083	936	12	—	107	4	24	2·6	*170*	*3·0*
King's Norton - -	3,931	2,607	18	—	469	6	831	21·3	*1,610*	*9·2*
Martley - - -	416	367	7	—	28	14	—	3·4	*62*	*2·9*
Pershore - - -	338	294	—	—	32	2	10	3·6	*48*	*2·7*
Shipston-on-Stour - -	428	375	1	—	25	6	21	6·3	*116*	*5·2*
Stourbridge - - -	3,124	2,735	10	—	321	27	31	1·9	*255*	*1·7*
Tenbury - - -	224	180	—	—	22	10	12	9·8	*42*	*4·4*
Upton-on-Severn - -	551	479	3	—	36	5	28	6·0	*146*	*5·5*
Worcester - - -	1,265	925	4	—	188	33	115	11·7	*950*	*14·6*
	18,873	15,054	85	—	2,045	185	1,504	8·9	*4,780*	*5·2*
YORK, East Riding.										
Beverley - - -	703	572	2	—	84	13	32	6·4	*294*	*6·2*
Bridlington - - -	468	362	2	—	55	3	46	10·5	*191*	*8·3*
Driffield - - -	513	438	4	—	60	6	5	2·1	*119*	*4·4*
Howden - - -	355	298	4	—	42	1	10	3·1	*66*	*3·6*
Kingston-upon-Hull -	2,621	2,002	12	—	367	11	229	9·2	*1,268*	*10·1*
Patrington - - -	226	183	—	—	25	—	18	8·0	*98*	*8·9*
Pocklington - - -	373	318	2	—	39	7	7	3·8	*99*	*5·0*
Sculcoates - - -	4,855	3,791	19	—	617	34	394	8·8	*1,442*	*6·3*
Skirlaugh - - -	244	207	—	—	24	2	11	5·3	*64*	*5·0*
York - - - -	2,422	1,960	9	1	295	33	124	6·5	*731*	*6·1*
	12,780	10,131	54	1	1,608	110	876	7·7	*4,302*	*6·9*

	Returns, 1898.								Children remaining "unaccounted for" when the Returns for the several Years were received.	
—	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	*Total Number for the Years 1888-98.*	*Average Percentage for the Years 1888-98.*
YORK, North Riding.										
Aysgarth - - -	124	111	1	—	9	—	3	2·4	*15*	*2·4*
Bedale - - -	196	177	1	—	11	—	7	3·6	*24*	*2·2*
Easingwold - - -	228	186	—	—	28	—	14	6·1	*61*	*5·2*
Guisborough - -	1,124	933	10	—	117	22	42	5·7	*308*	*4·9*
Helmsley - - -	135	117	1	—	8	6	3	6·7	*56*	*7·9*
Kirkby Moorside - -	141	115	—	—	19	3	4	5·0	*44*	*6·9*
Leyburn - - -	186	172	—	—	16	—	—	0·0	*17*	*1·9*
Malton - - -	620	480	2	—	89	6	43	7·9	*291*	*9·5*
Middlesbrough - -	4,376	3,565	13	—	576	61	161	5·1	*885*	*4·0*
Northallerton - -	304	265	—	—	35	3	1	1·3	*34*	*2·4*
Pickering - - -	325	244	—	—	51	14	16	9·2	*117*	*7·3*
Reeth - - -	67	56	—	—	7	2	2	6·0	*19*	*4·2*
Richmond - - -	346	286	2	—	43	—	15	4·3	*199*	*7·8*
Scarborough - -	1,238	545	5	—	182	—	506	40·9	*1,669*	*27·3*
Stokesley - - -	308	275	—	—	22	4	7	3·6	*41*	*2·7*
Thirsk - - -	322	279	1	—	33	2	7	2·8	*57*	*3·7*
Whitby - - -	685	551	1	—	57	15	11	4·1	*191*	*5·2*
	10,677	8,357	37	—	1,303	138	842	9·2	*3,958*	*7·3*
YORK, West Riding.										
Barnsley - - -	4,371	3,591	19	—	533	14	214	5·2	*1,620*	*8·5*
Bierley, North - -	3,778	2,292	16	—	466	31	968	26·5	*3,047*	*16·5*
Bradford - - -	5,730	3,687	29	1	820	50	1,143	20·8	*6,557*	*22·5*
Bramley - - -	2,230	1,617	13	—	303	1	296	13·3	*866*	*8·1*
Dewsbury - - -	4,758	2,000	11	—	784	77	1,886	41·3	*8,343*	*35·7*
Doncaster - - -	2,272	1,727	14	—	269	96	166	11·5	*789*	*7·8*
Goole - - -	866	704	6	—	96	3	57	6·9	*235*	*5·4*
Halifax - - -	4,701	392	1	—	616	—	3,692	78·5	*15,809*	*64·6*
Hemsworth - - -	650	514	—	—	85	7	44	7·8	*166*	*6·1*
Holbeck - - -	858	706	2	—	113	19	18	4·3	*212*	*4·9*
Huddersfield - -	4,107	3,578	42	—	368	12	107	2·9	*429*	*2·0*
Hunslet - - -	2,657	2,194	12	1	351	26	73	3·7	*470*	*3·7*
Keighley - - -	1,882	67	1	—	260	—	1,554	82·6	*7,790*	*81·3*
Knaresborough - -	710	488	4	—	110	26	82	15·2	*438*	*13·9*
Leeds - - -	7,276	5,925	33	—	896	70	352	5·8	*1,988*	*5·4*
Norton - - -	4,617	3,774	64	—	549	30	200	5·0	*1,047*	*4·8*
Ouseburn, Great - -	352	303	2	—	40	—	7	2·0	*61*	*3·5*
Pateley Bridge - -	184	166	3	—	14	—	1	0·5	*17*	*1·6*
Penistone - - -	557	502	—	—	43	6	6	2·2	*84*	*3·0*
Pontefract - - -	2,303	1,869	15	—	286	48	84	5·8	*515*	*4·7*
Ripon - - -	374	274	—	—	41	4	55	15·3	*218*	*10·3*
Rotherham - - -	3,754	3,045	15	—	446	29	219	6·6	*846*	*5·1*
Saddleworth - -	630	83	—	—	78	—	469	74·4	*1,222*	*40·0*
Sedbergh - - -	97	87	1	—	8	1	—	1·0	*10*	*2·0*
Selby - - -	443	385	—	—	37	11	10	4·7	*70*	*3·1*
Settle - - -	386	305	1	—	38	5	37	10·9	*94*	*5·0*
Sheffield - - -	7,735	6,055	56	—	1,040	34	550	7·6	*2,218*	*6·0*
Skipton - - -	1,129	478	4	—	125	32	490	46·2	*1,255*	*29·0*
Tadcaster - - -	867	739	5	—	71	—	52	6·0	*195*	*4·5*
Thorne - - -	432	344	—	—	41	24	23	10·9	*227*	*10·6*
Wakefield - - -	3,566	2,895	19	—	439	33	180	6·0	*841*	*4·9*
Wetherby - - -	386	300	2	—	44	16	24	10·4	*140*	*8·0*
Wharfedale - - -	1,335	988	15	—	144	18	170	14·1	*901*	*13·1*
Wortley - - -	1,512	1,212	5	—	159	27	109	9·0	*402*	*6·0*
	77,500	53,286	410	2	9,713	751	13,338	18·2	*58,969*	*15·8*

—	Returns, 1893. Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	Children remaining "unaccounted for" when the Returns for the several Years were received. *Total Number for the Years 1888–92.*	*Average Percentage for the Years 1888–92.*
ANGLESEY.										
Anglesey	390	339	—	—	36	1	14	3·8	*70*	*4·0*
Holyhead	522	451	—	—	46	7	18	4·8	*107*	*4·2*
	912	790	—	—	82	8	32	4·4	*177*	*4·1*
BRECKNOCK.										
Brecknock	402	362	—	—	33	2	5	1·7	*61*	*2·6*
Builth	219	184	—	—	28	2	5	3·2	*36*	*3·2*
Crickhowell	718	591	—	—	66	13	48	8·5	*275*	*8·4*
Hay	278	207	—	—	30	7	34	14·7	*74*	*5·5*
	1,617	1,344	—	—	157	24	92	7·2	*446*	*5·6*
CARDIGAN.										
Aberayron	304	265	—	—	34	1	4	1·6	*65*	*4·4*
Aberystwith	454	374	1	—	52	8	19	5·9	*104*	*4·3*
Cardigan	451	363	—	—	44	13	31	9·8	*120*	*6·0*
Lampeter	239	210	—	—	23	3	3	2·5	*42*	*3·4*
Tregaron	218	191	—	—	24	—	3	1·4	*33*	*3·1*
	1,666	1,403	1	—	177	25	60	5·1	*364*	*4·5*
CARMARTHEN.										
Carmarthen	914	807	2	—	82	8	15	2·5	*68*	*1·5*
Llandilofawr	655	573	—	—	72	4	6	1·5	*54*	*1·8*
Llandovery	278	245	—	—	27	6	—	2·2	*48*	*3·2*
Llanelly	1,845	1,579	—	—	205	26	35	3·3	*360*	*4·1*
Newcastle-Emlyn	506	442	—	—	55	4	5	1·8	*41*	*1·6*
	4,198	3,646	2	—	441	48	61	2·6	*571*	*2·8*
CARNARVON.										
Bangor and Beaumaris	992	838	2	—	106	9	37	4·6	*199*	*4·3*
Carnarvon	1,047	826	—	—	140	17	64	7·7	*464*	*8·7*
Conway	691	546	2	—	95	5	43	6·9	*138*	*4·6*
Pwllheli	518	407	—	—	56	23	32	10·6	*106*	*4·0*
	3,248	2,617	4	—	397	54	176	7·1	*909*	*5·8*
DENBIGH.										
Llanrwst	316	264	—	—	38	8	6	4·4	*70*	*4·4*
Ruthin	316	264	—	—	43	2	7	2·8	*16*	*1·1*
Wrexham	2,352	1,991	6	—	258	37	60	4·1	*482*	*4·8*
	2,984	2,519	6	—	339	47	73	4·0	*568*	*4·3*

—	Returns, 1893. Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	Children remaining "unaccounted for" when the Returns for the several Years were received. Total Number for the Years 1888–92.	Average Per-centage for the Years 1888–92.
FLINT.										
Asaph, St. - - -	726	623	1	—	75	2	25	3·7	115	3·4
Hawarden - - -	482	406	—	—	55	4	17	4·4	170	7·4
Holywell - -	1.287	1,078	1	—	132	30	46	5·9	376	6·3
	2,495	2,107	2	—	262	36	88	5·0	661	5·7
GLAMORGAN.										
Bridgend and Cowbridge -	1,998	1,661	7	—	251	32	47	4·0	278	3·2
Cardiff - - -	6,884	5,687	44	—	750	27	376	5·9	2,061	6·8
Gower - - -	334	275	—	—	20	—	39	11·7	81	5·2
Merthyr Tydfil - -	4,758	3,960	4	—	532	212	50	5·5	715	3·4
Neath - - -	2,311	2,008	1	—	247	22	33	2·4	238	2·4
Pontardawe - - -	900	798	—	—	92	8	2	1·1	93	2·5
Pontypridd - - -	6,918	5,643	1	—	275	52	247	4·3	1,348	4·7
Swansea - - -	4,255	3,670	6	—	435	—	144	3·4	653	3·3
	28,358	23,702	63	—	3,302	353	938	4·6	5,467	4·4
MERIONETH.										
Bala - - - -	144	113	—	—	23	4	4	5·6	40	5·6
Corwen - - -	436	373	—	—	34	15	14	6·7	96	4·5
Dolgelley - - -	345	283	—	—	52	7	3	2·9	56	3·2
Festiniog - - -	821	699	—	—	92	21	9	3·7	151	3·8
	1,746	1,468	—	—	201	47	30	4·4	343	4·0
MONTGOMERY.										
Forden - - -	426	372	—	—	33	9	12	4·9	90	4·6
Llanfyllin - - -	487	438	—	—	35	11	3	2·9	102	4·1
Machynlleth - -	291	260	—	—	21	6	4	3·4	40	2·6
Newtown and Llanidloes -	612	529	2	—	42	9	30	6·4	133	4·5
	1,816	1,599	2	—	131	35	49	4·6	365	4·1
PEMBROKE.										
Haverfordwest - -	994	817	—	—	109	20	48	6·8	392	8·4
Narberth - - -	454	398	—	—	44	6	6	2·6	88	3·7
Pembroke - - -	922	789	—	—	93	17	23	4·3	237	5·1
	2,370	2,004	—	—	246	43	77	5·1	717	6·1
RADNOR.										
Knighton - - -	314	134	—	—	42	7	131	43·9	286	18·7
Rhayader - - -	164	134	1	—	12	1	16	10·4	55	6·8
	478	268	1	—	54	8	147	32·4	341	14·6

No. 2.

APP. A. No. 2.

Inspection of Public Vaccination, 1895.

INSPECTION OF PUBLIC VACCINATION.

LIST (alphabetically arranged) of 302 UNIONS inspected during the Year 1895, with reference to the PROCEEDINGS under the VACCINATION ACTS, 1867 and 1871, and an ACCOUNT of the AWARDS certified by the BOARD as payable to the respective PUBLIC VACCINATORS out of COUNTY FUNDS.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Abergavenny - -	3	3	4 15 0	27 8 0	49 0 0	Dr. Fletcher.
Alcester - - -	5	4	6 7 0	9 17 0	33 13 0	„ Buchanan
Alresford - - -	2	2	6 8 0	7 6 0	13 14 0	Mr. Royle.
Alton - - -	4	2	11 1 0	13 18 0	24 19 0	Do.
Altrincham - -	6	5	6 8 0	33 0 0	75 14 0	Dr. Horne.
Alverstoke - -	1	1	—	—	42 10 0	Mr. Royle.
Amersham - -	6	5	5 0 0	19 12 0	42 4 0	Do.
Ampthill - - -	4	4	4 6 0	9 19 0	25 17 0	Do.
Andover - - -	5	3	3 16 0	5 8 0	9 4 0	Do.
Asaph, St. - -	5	4	6 8 0	13 10 0	40 10 0	Dr. Fletcher.
Aston - - -	7	6	7 0 0	50 0 0	164 8 0	„ Buchanan.
Atcham - - -	7	4	2 18 0	23 2 0	39 9 0	„ Wheaton.
Atherstone - -	2	2	11 0 0	23 5 0	34 5 0	„ Buchanan.
Austell, St. - -	7	5	3 9 0	15 1 0	39 12 0	„ Fletcher.
Aylsham - - -	7	3	4 7 0	5 18 0	15 10 0	„ Copeman.
Bala - - -	1	1	—	—	8 10 0	Dr. Fletcher.
Banbury - - -	6	3	1 2 0	3 13 0	7 1 0	„ Buchanan.
Bangor and Beaumaris -	6	4	6 3 0	21 0 0	44 19 0	„ Fletcher.
Barrow-on-Soar - -	6	—	—	—	—	Do.
Barton Regis - -	6	5	7 3 0	37 11 0	77 7 0	Mr. Royle.
Basford - - -	14	8	9 3 0	74 13 0	297 11 0	Do.
Basingstoke - -	7	4	0 14 0	6 2 0	17 9 0	Do.
Battle - - -	6	3	2 12 0	8 19 0	17 5 0	Dr. Sweeting.
Beaminster - -	5	2	2 10 0	5 19 0	8 9 0	Mr. Thompson.
Bedford - - -	8	7	2 16 0	11 2 0	32 0 0	„ Royle.
Bedwellty - -	7	4	15 9 0	51 6 0	120 0 0	Dr. Fletcher.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Bethnal Green - -	2	2	11 10 0	34 9 0	45 19 0	Dr. Sweeting.
Beverley - - -	6	2	0 18 0	23 16 0	24 14 0	" Reece.
Bicester - - -	7	4	1 3 0	7 17 0	12 11 0	" Buchanan.
Biggleswade - -	6	6	1 5 0	4 0 0	13 6 0	Mr. Royle.
Billesdon - - -	3	2	1 5 0	5 15 0	7 0 0	Dr. Fletcher.
Bingham - - -	5	3	5 0 0	9 7 0	20 4 0	Mr. Royle.
Blaby - - -	3	—	—	—	—	Dr. Fletcher.
Blandford - -	4	3	2 5 0	10 5 0	16 18 0	Mr. Thompson.
Bodmin - - -	7	6	2 19 0	5 1 0	23 11 0	Dr. Fletcher.
Boston - - -	8	5	2 8 0	16 1 0	42 3 0	Do.
Bourne - - -	6	3	3 5 0	6 11 0	14 10 0	Dr. Bruce Low.
Bradford-on-Avon -	3	3	2 18 0	8 14 0	18 2 0	Mr. Royle.
Braintree - - -	7	7	3 3 0	16 2 0	52 15 0	Dr. Bulstrode.
Bridgend and Cowbridge	7	6	14 11 0	37 5 0	154 19 0	Mr. Evans.
Bridgnorth - -	3	3	2 19 0	17 6 0	27 8 0	Dr. Wheaton.
Bridlington - -	4	3	2 6 0	8 14 0	15 12 0	" Reece.
Bridport - - -	3	2	2 6 0	16 1 0	18 7 0	Mr. Thompson.
Brighton - - -	2	2	44 3 0	44 13 0	88 16 0	Dr. Sweeting.
Bristol - - -	1	1	—	—	6 15 0	" Barry.
Bromsgrove - -	5	5	1 8 0	25 2 0	52 11 0	" Wheaton.
Bromyard - - -	3	2	7 3 0	8 11 0	15 14 0	Do.
Burton-on-Trent -	8	5	3 17 0	44 8 0	81 8 0	Do.
Bury St. Edmunds -	1	1	—	—	23 18 0	Dr. Reece.
Caistor - - -	8	5	1 2 0	6 1 0	20 4 0	Dr. Bruce Low.
Camberwell - -	5	4	30 18 0	74 19 0	228 6 0	" Sweeting.
Cambridge - -	1	1	—	—	51 11 0	" Reece.
Camelford - -	2	1	—	—	4 3 0	" Fletcher,
Cannock - - -	6	3	0 11 0	13 6 0	19 3 0	" Wheaton.
Cardiff - - -	8	7	2 14 0	130 4 0	257 18 0	Mr. Evans.
Carnarvon - -	4	2	6 2 0	23 17 0	29 19 0	Dr. Fletcher.
Catherington - -	1	1	—	—	3 10 0	Mr. Royle.
Caxton and Arrington -	4	4	1 13 0	7 9 0	18 0 0	Dr. Reece.
Cerne - - -	3	3	0 15 0	6 14 0	13 1 0	Mr. Thompson.
Chailey - - -	4	4	1 5 0	10 9 0	24 7 0	Dr. Sweeting.
Cheadle - - -	5	5	9 10 0	20 13 0	66 5 0	" Wheaton.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Chelsea - - -	2	2	28 19 0	70 14 0	99 13 0	Dr. Sweeting.
Cheltenham - -	3	3	2 18 0	21 18 0	33 8 0	Mr. Royle.
Chepstow - - -	5	1	—	—	6 7 0	Dr. Fletcher.
Chesterton - -	7	5	6 8 0	11 11 0	44 14 0	„ Reece.
Chichester - -	1	—	—	—	—	„ Sweeting.
Chipping Norton -	4	3	4 3 0	12 18 0	21 17 0	„ Buchanan.
Chipping Sodbury -	5	3	4 7 0	5 13 0	14 19 0	Mr. Royle.
Christchurch - -	3	3	8 1 0	25 15 0	44 13 0	Do.
Church Stretton - -	4	4	1 2 0	5 7 0	11 16 0	Dr. Wheaton.
Cirencester - -	5	4	1 0 0	7 1 0	20 0 0	Mr. Royle.
Cleobury Mortimer -	2	2	8 11 0	9 2 0	17 13 0	Dr. Wheaton.
Clun - - -	4	3	2 16 0	7 5 0	13 15 0	Do.
Columb, St., Major -	6	3	2 18 0	5 2 0	12 19 0	Dr. Fletcher.
Conway - - -	3	3	11 0 0	14 18 0	40 15 0	Do.
Corwen - - -	3	2	4 1 0	8 19 0	13 0 0	Do.
Coventry - - -	1	1	—	—	1 2 0	Dr. Barry.
Cuckfield - - -	6	6	1 6 0	12 18 0	50 2 0	„ Sweeting.
Daventry - - -	*6*	*1**	—	—	*9 5 0*	Dr. Horne.
Docking - - -	4	3	6 7 0	18 15 0	33 12 0	„ Copeman.
Dolgelley - - -	5	5	2 10 0	9 13 0	24 10 0	„ Fletcher.
Dorchester - -	6	6	0 18 0	11 5 0	25 16 0	Mr. Thompson.
Dore - - -	3	2	4 11 0	4 14 0	9 5 0	Dr. Wheaton.
Drayton - - -	5	4	1 10 0	11 9 0	22 7 0	Do.
Driffield - - -	8	7	2 3 0	8 15 0	28 15 0	Dr. Reece.
Droitwich - - -	6	5	0 18 0	13 0 0	39 6 0	„ Wheaton.
Droxford - - -	4	2	4 13 0	6 17 0	11 10 0	Mr. Royle.
Dunmow - - -	6	4	4 15 0	8 10 0	25 18 0	Dr. Bulstrode.
Dursley - - -	3	2	1 4 0	3 7 0	6 11 0	Mr. Royle.
Easingwold - -	4	3	2 13 0	5 2 0	10 17 0	Dr. Copeman.
Eastbourne - -	4	2	3 15 0	4 3 0	7 18 0	„ Sweeting.
East Grinstead - -	6	6	2 13 0	11 7 0	37 9 0	Do.
East Preston - -	3	1	—	—	15 0 0	Do.
East Retford - -	6	5	3 5 0	21 16 0	45 14 0	Mr. Royle.

* Specially inspected in 1895.

App. A. No. 2.

Inspection of Public Vaccination, 1895.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Ellesmere - - -	6	—	—	—	—	Dr. Wheaton.
Ely - - -	5	2	3 17 0	12 13 0	16 10 0	" Reece.
Erpingham - -	3	1	—	—	17 10 0	" Copeman.
Exeter - - -	1	1	—	—	15 0 0	" Barry.
Faith, St. - - -	5	5	0 5 0	7 18 0	21 2 0	Dr. Copeman.
Falmouth - - -	4	3	0 9 0	1 16 0	3 19 0	" Fletcher.
Fareham - - -	4	3	2 8 0	10 16 0	23 4 0	Mr. Royle.
Festiniog - - -	5	3	6 11 0	15 5 0	29 0 0	Dr. Fletcher.
Foleshill - - -	5	3	1 10 0	15 17 0	21 12 0	" Buchanan.
Fordingbridge - -	2	2	8 8 0	8 13 0	17 1 0	Mr. Royle.
Forehoe - - -	6	5	1 11 0	15 6 0	28 0 0	Dr. Copeman.
Gainsborough - -	8	7	2 10 0	11 0 0	34 18 0	Dr. Bruce Low.
George, St., East - -	1	1	—	—	104 14 0	" Sweeting.
Germans, St. - -	6	4	2 10 0	8 16 0	21 0 0	" Fletcher.
Glanford Brigg - -	9	7	5 8 0	20 18 0	67 10 0	" Bruce Low.
Gloucester - -	2	1	—	—	1 5 0	Mr. Royle.
Gower - - -	3	3	4 11 0	14 4 0	29 3 0	" Evans.
Grantham - -	7	7	2 1 0	10 14 0	39 2 0	Dr. Bruce Low.
Grimsby - - -	4	1	—	—	5 15 0	Do.
Guisborough - -	7	4	5 6 0	11 16 0	28 17 0	Dr. Copeman.
Hackney - - -	4	3	12 13 0	18 13 0	48 17 0	Dr. Sweeting.
Hailsham - - -	7	1	—	—	4 15 0	Do.
Halstead - - -	5	5	3 2 0	18 1 0	43 12 0	Dr. Bulstrode.
Hampstead - -	1	1	—	—	18 4 0	" Sweeting.
Hartley Wintney -	7	5	1 7 0	9 0 0	24 7 0	Mr. Royle.
Hastings - - -	2	1	—	—	1 17 0	Dr. Sweeting.
Havant - - -	4	4	1 16 0	4 7 0	13 5 0	Mr. Royle.
Hawarden - -	3	1	—	—	10 2 0	Dr. Fletcher
Headington - -	2	2	10 9 0	70 13 0	81 2 0	" Buchanan.
Helmsley - - -	2	1	—	—	1 15 0	" Copeman.
Helston - - -	5	4	5 4 0	9 0 0	29 2 0	" Fletcher.
Hemsworth - -	4	4	1 14 0	15 8 0	35 15 0	" Horne.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Henley	6	4	4 0 0	5 11 0	19 0 0	Dr. Buchanan.
Henstead	5	3	2 4 0	3 11 0	9 4 0	„ Copeman.
Hereford	4	2	6 7 0	28 7 0	34 14 0	„ Wheaton.
Holbeach	6	2	0 6 0	10 15 0	11 1 0	„ Fletcher.
Holywell	4	3	19 7 0	26 6 0	66 1 0	Do.
Horncastle	6	4	3 9 0	6 2 0	20 8 0	Do.
Horsham	7	8	2 1 0	23 5 0	57 8 0	Dr. Sweeting.
Howden	4	2	4 10 0	9 8 0	13 18 0	„ Reece.
Hursley	1	1	—	—	6 12 0	Mr. Royle.
Ipswich	1	1	—	—	31 3 0	Dr. Reece.
Islington	5	1	—	—	71 9 0	„ Sweeting.
Keighley	5	—	—	—	—	Dr. Horne.
Kidderminster	5	5	5 10 0	34 18 0	62 18 0	„ Wheaton.
Kingsclere	3	3	2 9 0	8 2 0	14 16 0	Mr. Royle.
Kingston-on-Hull	2	2	35 1 0	73 2 0	108 3 0	Dr. Reece.
Kington	5	2	1 3 0	5 13 0	6 16 0	„ Wheaton.
Kirkby Moorside	1	1	—	—	6 17 0	„ Copeman.
Knaresborough	3	1	—	—	12 7 0	„ Horne.
Lambeth	5	5	13 2 0	72 13 0	249 1 0	Dr. Sweeting.
Launceston	8	4	1 9 0	5 5 0	13 14 0	„ Fletcher.
Ledbury	3	3	2 12 0	7 8 0	15 18 0	„ Wheaton.
Leeds	7	7	2 1 0	74 6 0	214 10 0	„ Barry.
Leek	6	5	3 5 0	22 19 0	47 18 0	„ Wheaton.
Leicester	2	1	—	—	0 15 0	„ Fletcher.
Leighton Buzzard	2	—	—	—	—	Mr. Royle.
Leominster	3	2	7 3 0	14 17 0	22 0 0	Dr. Wheaton.
Lewes	1	1	—	—	11 5 0	„ Sweeting.
Lewisham	5	5	3 11 0	21 13 0	76 2 0	Do.
Lichfield	6	4	3 3 0	25 0 0	58 14 0	Dr. Wheaton.
Lincoln	12	11	2 3 0	19 5 0	66 12 0	„ Bruce Low
Linton	3	2	10 12 0	13 15 0	24 7 0	„ Reece.
Liskeard	8	1	—	—	1 13 0	„ Fletcher.
London, City of	2	2	6 0 0	8 18 0	14 18 0	„ Sweeting.

App. A. No. 2.

Inspection of Public Vaccination, 1895.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Loughborough	4	4	0 8 0	2 18 0	6 16 0	Dr. Fletcher.
Louth	11	10	3 4 0	11 1 0	59 16 0	" Bruce Low.
Ludlow	5	3	3 6 0	6 6 0	13 15 0	" Wheaton.
Luton	5	1	—	—	0 15 0	Mr. Royle.
Lymington	4	4	3 8 0	9 6 0	24 13 0	Do.
Madeley	4	4	4 12 0	17 14 0	40 12 0	Dr. Wheaton.
Malmesbury	4	3	6 9 0	8 17 0	22 11 0	Mr. Royle.
Malton	6	5	2 14 0	4 19 0	20 1 0	Dr. Copeman.
Mansfield	6	4	13 10 0	44 1 0	107 5 0	Mr. Royle.
Martley	7	3	3 3 0	6 19 0	13 18 0	Dr. Wheaton.
Marylebone	2	2	64 4 0	82 13 0	146 17 0	" Sweeting.
Melksham	2	2	8 14 0	9 19 0	18 13 0	Mr. Royle.
Meriden	3	3	1 0 0	7 4 0	14 18 0	Dr. Buchanan.
Merthyr Tydfil	11	9	10 11 0	88 4 0	336 8 0	Mr. Evans.
Middlesbrough	4	4	7 2 0	95 16 0	175 11 0	Dr. Copeman.
Midhurst	5	4	6 12 0	15 17 0	43 16 0	" Sweeting.
Mildenhall	2	1	—	—	11 6 0	" Reece.
Mile End Old Town	2	2	44 15 0	52 12 0	97 7 0	" Sweeting.
Monmouth	6	3	3 12 0	30 1 0	39 5 0	" Fletcher.
Neath	6	5	26 2 0	54 16 0	191 8 0	Mr. Evans.
Newark	8	8	1 8 0	43 15 0	74 10 0	" Royle.
Newcastle-under-Lyme	3	2	40 8 0	50 14 0	91 2 0	Dr. Wheaton.
Newent	3	3	5 19 0	7 18 0	21 5 0	Mr. Royle.
New Forest	5	3	1 1 0	18 11 0	24 13 0	Do.
Newhaven	5	5	1 10 0	20 8 0	32 11 0	Dr. Sweeting.
Newmarket	8	5	7 5 0	19 4 0	58 1 0	" Reece.
Newport (Mon.)	9	5	2 0 0	71 18 0	182 17 0	" Fletcher.
Newport (Salop)	4	4	5 14 0	9 5 0	30 3 0	" Wheaton.
Northallerton	4	1	—	—	3 6 0	" Copeman.
Northleach	4	5	1 16 0	7 11 0	20 14 0	Mr. Royle.
North Witchford	6	3	4 14 0	8 12 0	18 11 0	Dr. Reece.
Nottingham	3	3	45 11 0	85 16 0	195 14 0	Mr. Royle.
Nuneaton		2	2 5 0	3 16 0	6 1 0	Dr. Buchanan.

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			£ s. d.	£ s. d.	£ s. d.	
Ormskirk - - -	9	4	6 19 0	38 6 0	77 5 0	Dr. Fletcher.
Oswestry - - -	5	4	4 3 0	29 9 0	60 10 0	„ Wheaton.
Oxford - - -	1	—	—	—	—	„ Bulstrode.
Pancras, St. - -	1	1	—	—	148 15 0	Dr. Sweeting.
Patrington - -	5	2	0 18 0	2 14 0	3 12 0	„ Reece.
Penzance - - -	5	4	3 4 0	14 17 0	39 3 0	„ Fletcher.
Petersfield - -	4	4	3 10 0	9 2 0	24 3 0	Mr. Royle.
Petworth - - -	4	2	4 12 0	9 14 0	14 6 0	Dr. Sweeting.
Pickering - - -	3	2	2 3 0	5 7 0	7 10 0	„ Copeman.
Pocklington - -	6	4	2 17 0	6 3 0	16 12 0	„ Reece.
Pontefract - -	7	7	2 0 0	34 3 0	97 18 0	„ Horne.
Pontypool - - -	4	1	—	—	36 9 0	„ Fletcher.
Pontypridd - -	9	8	14 12 0	120 3 0	465 12 0	Mr. Evans.
Poole - - -	4	4	2 8 0	10 17 0	22 1 0	„ Thompson.
Portsea Island - -	1	1	—	—	97 10 0	„ Royle.
Pwllheli - - -	6	1	—	—	8 8 0	Dr. Fletcher.
Redruth - - -	6	4	2 5 0	21 1 0	40 10 0	Dr. Fletcher.
Ringwood - - -	1	1	—	—	14 9 0	Mr. Royle
Ripon - - -	4	2	2 12 0	3 16 0	6 8 0	Dr. Horne.
Romsey - - -	4	3	1 0 0	15 15 0	19 9 0	Mr. Royle.
Ross - - -	4	—	—	—	—	Dr. Wheaton.
Rugby - - -	8	5	2 7 0	6 17 0	19 16 0	„ Buchanan.
Rye - - -	3	1	—	—	17 16 0	„ Sweeting.
Saddleworth - -	1	1	—	—	3 8 0	Dr. Horne.
Saffron Walden - -	6	5	1 10 0	18 19 0	35 7 0	„ Bulstrode.
Scarborough -	6	5	2 17 0	5 10 0	18 10 0	„ Copeman.
Sculcoates - - -	7	2	1 6 0	77 4 0	78 10 0	„ Reece.
Sedbergh - - -	2	—	—	—	—	„ Horne.
Seisdon - - -	4	4	3 6 0	6 3 0	17 17 0	„ Wheaton.
*Sevenoaks** - -	*6*	*1*	—	—	*7 13 0*	„ Sweeting
Shaftesbury - -	3	2	3 16 0	7 1 0	10 17 0	Mr. Thompson.
Sheffield - - -	6	6	28 8 0	70 10 0	318 1 0	Dr. Barry.
Sherborne - - -	3	3	3 18 0	6 18 0	16 13 0	Mr. Thompson.

* Inspected in 1894.

Ap. A. No. 2.

Inspection of Public Vaccination, 1895.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Shifnal	4	2	5 17 0	8 5 0	14 2 0	Dr. Wheaton.
Shoreditch	3	3	39 18 0	98 4 0	195 17 0	" Sweeting.
Skirlaugh	5	2	2 15 0	7 8 0	10 3 0	" Reece.
Sleaford	7	5	3 0 0	10 1 0	30 1 0	" Bruce Low.
Smallburgh	4	2	10 6 0	14 10 0	24 16 0	" Copeman.
Solihull	4	4	4 6 0	17 6 0	34 19 0	" Buchanan.
Southam	4	3	1 19 0	9 9 0	16 11 0	Do.
Southampton	2	2	50 2 0	67 13 0	117 15 0	Mr. Royle.
South Stoneham	6	6	8 16 0	31 16 0	105 11 0	Do.
Southwell	7	7	1 11 0	11 3 0	38 8 0	Do.
Spalding	7	3	4 13 0	6 9 0	17 9 0	Dr. Fletcher.
Spilsby	7	6	1 9 0	8 1 0	30 14 0	" Bruce Low.
Stafford	4	3	7 12 0	13 19 0	34 17 0	" Wheaton.
Stamford	7	3	0 4 0	14 0 0	15 12 0	" Fletcher.
Steyning	6	6	7 6 0	48 13 0	114 18 0	" Sweeting.
Stockbridge	2	1	—	—	8 15 0	Mr. Royle.
Stockport	5	3	23 3 0	30 7 0	83 16 0	Dr. Horne.
Stokesley	4	4	2 14 0	6 9 0	18 18 0	" Copeman.
Stoke-upon-Trent	5	5	8 18 0	58 8 0	192 1 0	" Wheaton.
Stone	4	4	2 2 0	18 6 0	40 11 0	Do.
Stow-on-the-Wold	2	2	6 15 0	8 6 0	15 1 0	Mr. Royle.
Stratford-on-Avon	7	5	1 14 0	16 8 0	32 6 0	Dr. Buchanan.
Stratton	2	—	—	—	—	" Fletcher.
Stroud	6	5	3 9 0	7 4 0	25 15 0	Mr. Royle.
Sturminster	4	4	3 1 0	7 8 0	17 7 0	" Thompson.
Swaffham	5	4	1 9 0	8 4 0	19 4 0	Dr. Copeman.
Tamworth	3	2	15 7 0	17 10 0	32 17 0	Dr. Wheaton.
Tenbury	2	1	—	—	7 14 0	Do.
Tetbury	2	1	—	—	6 10 0	Mr. Royle.
Tewkesbury	4	2	2 1 0	2 3 0	4 4 0	Do.
Thakeham	2	2	4 17 0	13 3 0	18 0 0	Dr. Sweeting.
Thame	6	5	0 13 0	6 19 0	21 14 0	" Bulstrode.
Thingoe	8	7	1 2 0	8 8 0	30 5 0	" Reece.
Thirsk	6	6	1 5 0	6 14 0	14 8 0	" Copeman.

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			£ s. d.	£ s. d.	£ s. d.	
Thornbury	4	3	1 4 0	14 14 0	26 16 0	Mr. Royle.
Ticehurst	8	6	0 18 0	11 16 0	35 18 0	Dr. Sweeting.
Todmorden	2	2	1 16 0	5 17 0	7 13 0	Mr. Evans.
Truro	7	2	1 8 0	8 10 0	9 18 0	Dr. Fletchee.
Uckfield	6	3	8 1 0	13 4 0	32 0 0	Dr. Sweeting.
Upton-on-Severn	6	5	0 19 0	20 14 0	44 9 0	" Wheaton.
Uttoxeter	5	5	1 9 0	9 12 0	21 11 0	Do.
Walsall	4	4	10 5 0	42 5 0	81 5 0	Dr. Wheaton.
Walsingham	5	2	9 12 0	9 17 0	19 9 0	" Copeman.
Wandsworth and Clapham.	8	7	10 8 0	61 15 0	230 18 0	" Sweeting.
Wareham and Purbeck	7	2	3 15 0	4 18 0	8 13 0	Mr.Thompson.
Warwick	3	1	—	—	19 11 0	Dr. Buchanan.
Wayland	2	2	12 1 0	15 9 0	27 10 0	" Copeman.
Wellington (Salop)	3	2	19 16 0	23 4 0	43 0 0	" Wheaton.
Wem	4	3	2 5 0	7 19 0	14 19 0	Do.
Weobley	3	2	3 12 0	5 0 0	8 12 0	Do.
Westbourne	3	3	2 1 0	9 9 0	17 11 0	Dr. Sweeting.
West Bromwich	5	5	10 16 0	36 2 0	119 1 0	" Wheaton.
Westbury-on-Severn	5	3	2 17 0	5 2 0	11 9 0	Mr. Royle.
Westbury and Whorwellsdown.	4	4	1 9 0	11 18 0	20 2 0	Do.
West Firle	3	2	1 5 0	1 7 0	2 12 0	Dr. Sweeting.
West Ham	9	7	17 9 0	138 7 0	581 19 0	" Buchanan.
Westhampnett	5	3	4 7 0	9 0 0	22 2 0	" Sweeting.
Weymouth	6	5	3 3 0	10 2 0	33 13 0	Mr.Thompson.
Wheatenhurst	2	1	—	—	1 0 0	" Royle.
Whitby	4	3	2 19 0	7 6 0	17 1 0	Dr. Copeman.
Whitchurch (Hants)	3	3	3 14 0	8 18 0	18 10 0	Mr. Royle.
Whitchurch (Salop)	3	1	—	—	1 16 0	Dr. Wheaton.
Whittlesey	2	1	—	—	3 9 0	" Reece.
Wight, Isle of	9	9	2 8 0	25 13 0	100 6 0	Mr. Royle.
Wimborne and Cranborne.	4	2	9 5 0	9 6 0	18 11 0	" Thompson.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Winchcomb	2	2	3 10 0	10 9 0	13 19 0	Mr. Royle.
Winchester, New	4	3	7 9 0	26 9 0	43 14 0	Do.
Wisbech	14	9	0 19 0	14 3 0	46 0 0	Dr. Reece.
Witney	4	3	9 7 0	12 16 0	34 4 0	„ Bulstrode.
Woburn	2	2	4 3 0	6 7 0	10 10 0	Mr. Royle.
Wolstanton and Burslem	3	3	29 13 0	42 18 0	105 16 0	Dr. Wheaton.
Wolverhampton	5	2	8 11 0	27 3 0	35 14 0	Do.
Woodstock	4	3	3 19 0	9 13 0	22 19 0	Dr. Buchanan.
Woolwich	4	4	3 18 0	75 1 0	109 8 0	„ Sweeting.
Worcester	1	1	—	—	28 7 0	„ Wheaton.
Worksop	7	4	1 19 0	45 14 0	59 13 0	Mr. Royle.
Wycombe	10	9	2 17 0	18 11 0	87 0 0	Do.
York	6	4	2 5 0	112 15 0	128 14 0	Dr. Reece.
Total	1,491	980	—	—	13,400 9 0	

No. 3.

Statistics of the National Vaccine Establishment and Educational Vaccination Stations.

I.—Staff at end of March 1896.

N.B.—The Stations named in *italics* are Educational Vaccination Stations authorised by the Local Government Board.

Description of Vaccinator.	Name of Vaccinator.	Vaccination Stations.	Days and Hours of Attendance.
Vaccinators supplying lymph for the public service and salaried from the Parliamentary grant.	1. Dr. R. Cory	*Surrey Chapel*	Tues., Thurs.; 2.
	2. Mr. Joseph Loane	*Tottenham Court Chapel.*	Mon., Wednes.; 1.
Parochial and other Vaccinators not salaried from the Parliamentary grant, but contributing lymph at a fixed rate of payment.	1. Dr. A. C. Clarke	*Salford*	Thursday; 2.
	2–6. Dr. Edmund Robinson.	*Birmingham*	Monday, Tuesday, Wednesday; 11. Wednesday; 2. Thursday; 11.
	7. Mr. N. E. Roberts	*Liverpool*	Tuesday; 1.
	8. Mr. J. Hawthorn	*Newcastle-on-Tyne.*	Wednesday; 3.
	9. Dr. A. E. Cope	*Westminster*	Monday; 10.
	10–11. Mr. E. C. Greenwood	*Marylebone*	Tuesday; 2. Wednesday; 10
	12. Mr. J. Loane	*Whitechapel*	Wednesday; 11.
	13. Mr. Frederick Holmes	*Leeds*	Tuesday; 2.30.
	14. Dr. Edward Lynes	Coventry	Tuesday; 12.
	15–16. Dr. Hugh Thomson	*Glasgow*	Monday; 2. Mon., Thurs.; 12.
	17. Mr. J. F. Staines	*Endell Street*	Tuesday; 10.
	18. Mr. W. Skinner	*Sheffield*	Tuesday; 3.
	19. Dr. G. A. Miskin	Waterloo	Tuesday; 2.
	20. Dr. J. B. Buist	*Edinburgh*	Thursday; 3.
	21. Dr. R. Cory	*St. Thomas's Hospital.*	Wednesday; 11.30.
	22. Mr. J. W. Nicol	*Glasgow West*	Monday; 1.
	23. Dr. William A. Budd	*Exeter*	Thursday; 3.
	24. Mr. R. G. McKerron	*Aberdeen*	Wednesday; 2.30.
	25. Mr. J. Llewellyn Treharne.	*Cardiff*	Monday; 12.
Teachers of Vaccination not supplying lymph.	Dr. W. Husband	*Edinburgh*	Wednes., Sat.; 12.
	Mr. V. A. Jaynes	*Horsleydown*	Wednesday; 3.
	Dr. A. N. Montgomery	*Dublin*	Tues., Fri.; 10.
	Dr. R. Cory	*Cambridge*	Friday; 11.

II.—Animal Vaccine Station.

The Animal Vaccine Station is at 95, Lamb's Conduit Street, where Dr. R. Cory and Mr. T. S. Stott attend for the Vaccination of Children on Tuesdays and Thursdays, at 10.30 a.m.

III.—Sources and Amount of Lymph Supply in 1895.

N.B.—The Stations named in *italics* are Educational Vaccination Stations authorised by the Local Government Board.

Description of Vaccinator.	Vaccination Stations.	Number of Vaccinations performed at the Stations respectively.		Number of Charges of Lymph supplied from the Stations respectively.	
		Primary.	Re-vaccinations.	Charged Ivory Points.	Charged Tubes each estimated as equal to 10 Ivory Points.
Vaccinators salaried from the Parliamentary grant.	1. *Surrey Chapel*	173	13	53	—
	2. *Tottenham Court Chapel.*	327	15	—	91
	Total -	500	28	53	91
Parochial and other Vaccinators not salaried from the Parliamentary grant, but contributing lymph at a fixed rate of payment.	1. *Salford* - -	164	—	—	6
	2–6. *Birmingham* -	3,522	221	—	616
	7. *Liverpool* -	556	79	—	94
	8. *Newcastle-on-Tyne.*	450	10	—	18
	9. *Westminster** -	172	2	—	—
	10–11. *Marylebone*	1,219	44	—	—
	12. *Whitechapel* -	1,875	11	—	784
	13. *Leeds* - -	642	1	—	—
	14. Coventry -	14	4	—	—
	15–16. *Glasgow* -	1,003	—	—	—
	17. *Endell Street* -	169	14	—	60
	18. *Sheffield* - -	508	—	—	—
	19. Waterloo -	1,289	3	—	2,062
	20. *Edinburgh* -	301	31	—	—
	21. *St. Thomas's Hospital.*	177	5	—	—
	22. *Glasgow West*†	383	1	—	55
	23. *Exeter* - -	408	3	—	2
	24. *Aberdeen* -	383	1	—	—
	Total -	13,235	430	—	3,697
	Grand Total -	13,735	458	53	3,788

* For four months only. † For nine months only.

III.—Sources and Amount of Lymph—*continued.*

During the year, additional supplies (to the extent of 3,163 charged tubes) were obtained from the following gentlemen:—

Dr. R. S. Archer, Everton.
Mr. J. Bark, Kirkdale.
Dr. F. Cadell, Edinburgh.
Dr. R. F. Cook, Gateshead.
Dr. W. H. Kempster, Battersea.
Mr. A. Meeson, Toxteth Park.
Dr. G. A. Miskin, Kennington.

IV.—Distribution of Human Lymph, 1895.

Number of applications:	
From Medical Practitioners in England and Wales	3,237
,, ,, ,, Scotland	66
,, the Navy and from the Emigration Department	40
,, India and the Colonies	44
,, Diplomatic and other Foreign Services	13
Supplies sent out:—	
Charged ivory points	50
,, capillary tubes	6,166

V.—Distribution of Calf-Lymph, 1895.

Number of applications	1,847
Supplies received:—	
Charged ivory points	13,278
,, capillary tubes	58
Supplies sent out:—	
Charged ivory points	11,903
,, capillary tubes	58

No. 4.

App. A. No. 4.

On the Operations of the Animal Vaccine Establishment, 1895-96; by Dr. Cory.

REPORT on the OPERATIONS of the ANIMAL VACCINE STATION, at 95, LAMB'S CONDUIT STREET, during the year 1895–96; by Dr. R. CORY.

During the year, 1st April 1895 to 31st March 1896, 261 calves were received at Lamb's Conduit Street. All of these (males, 222; females, 39) were vaccinated for the purposes of the station.

The aggregate weight on reception at Lamb's Conduit Street of the 261 calves was—males, 65,872 lbs.; females, 11,990 lbs. On dismissal from the station their weights were, respectively, 72,902 lbs. and 13,110 lbs., so that during retention for vaccination purposes calves of both sexes gained considerably in weight; males by an average of 31·7 lbs., females by an average of 28·72 lbs.

Of the above calves, 256 were vaccinated with lymph derived directly from other calves, and five were vaccinated with calf lymph which had been stored. As usual, vaccinations performed with direct lymph proved much more successful than those performed with stored lymph. In 256 calf-to-calf operations, 18,129 insertions produced 17,310 vesicles, and in five stored-lymph operations, 248 insertions produced 162 vesicles. The rates of insertion success were, respectively, 95·5 and 65·3 per cent. No material difference in the results of calf-to-calf vaccinations was observed, whether the lymph used was from calves vaccinated 96, or from calves vaccinated 120, hours previously; in both cases the rate of insertion success was, practically, 95·5 per cent.

Primary Vaccinations.—During the year, 6,802 persons received primary vaccination at the station; five separate insertions of lymph being made in each instance. Of these persons, 3,345 were males and 3,457 females. In all but 17 of the primarily vaccinated persons who returned for inspection the operation succeeded at the first attempt, and in no case was a third attempt at vaccination requisite. The amount of insertion success obtained by each of three several operators was as follows:—Of 363 persons primarily vaccinated by Mr. Stott, two failed to return for inspection. Of the 361 remaining, 331 were, on examination, found to have taken in 5 places, 17 in four, 10 in three, and 3 in two. Mr. Stott's insertion success rate was, therefore, 97·45 per cent.

Of 562 persons primarily vaccinated by Dr. Savory, acting for Mr. Stott or myself in the absence of one or other of us, three failed to return for inspection. Of the 559 remaining 502 were found to have taken n five places, 26 in four, 13 in three, 12 in two, 3 in one, and 3 were not successful on the first attempt. Dr. Savory's success rate, therefore, was 95·9 per cent.

Of 21 persons primarily vaccinated by occasional assistants, 14 were found to have taken in five places, 5 in four places, 1 in two places, and 1 in one; yielding an insertion success rate of 88·57 per cent.

Of 5,856 persons primarily vaccinated by myself, 61 who failed to return for inspection, and other 7, all of whom were operated on for the cure of nævi, are not taken into account in these statistics. Of the 5,788 remaining, 5,456 were found to have taken in five places, 192 in four, 65 in three, 37 in two, 24 in one, while in 14 cases vaccination proved unsuccessful on the first trial; an insertion success rate of 97·93 per cent.

Re-vaccinations.—These during the year numbered 365. Mr. Stott performed 25, Dr. Savory, 35, occasional assistants, 13, and I, myself, 292. Of these latter, 255 were successful in five places, 16 in four, 7 in three, 1 in one, and 3 were unsuccessful. Other 10 did not return for

inspection. My insertion success rate, therefore, in re-vaccinations was 96·52 per cent.; Mr. Stott's was 99·2; Dr. Savory's, 98·24; and the insertion success rate of the assistants was 92·31 per cent.

App. A. No. 4.

On the Operations of the Animal Vaccine Establishment, 1895-96; by Dr. Cory.

In all, 56 cases returned to the station after "inspection" on account of some abnormal course of their vaccinations. The abnormality consisted in the main of sore arms. Fifteen were cases of transient eruption, three were cases of glandular abscess, and three of erysipelas. Only one case among all those vaccinated or re-vaccinated is known to have had a fatal termination. This was a child vaccinated on the 30th July 1895 and who died of erysipelas on the 7th September 1895. The infant in question was not brought to the station subsequent to commencement of its erysipelas.

The average body temperature of 35 female calves, taken in the rectum before vaccination, was 102·34°, and the average temperature of the same calves taken five days after vaccination was 103·34°. The average body temperature of 223 males before vaccination was 102·44°, and the average temperature of the same calves five days after vaccination was 103·26°.

No. 5.

App. A. No. 5.

Abstract of Medical Inspections.

ABSTRACT of MEDICAL INSPECTIONS made in 1895 with regard to the INCIDENCE of DISEASE on particular places, and to questions concerning LOCAL SANITARY ADMINISTRATION.

1. BRECKNOCK RURAL DISTRICT (BRECKNOCKSHIRE); population (1891), 10,130; Dr. Fletcher.

Authority concerned: Brecknock Rural District Council.

Grounds of Inquiry: Medical Officer of Health arrangements, and general sanitary condition and administration.

Chief Facts reported by Inspector: Water supply.—Much work already done by the Authority, but supplies still urgently required for several villages

Sewerage.—None in the district, but a joint scheme in contemplation for Senny Bridge and Devynnock. Several other villages in need of systematic drainage.

Closet accommodation.—Unsatisfactory, and in places deficient.

Infectious Disease (Notification) Act, 1889, and Infectious Disease (Prevention) Act, 1890, in force in the district. No portion of Public Health Acts Amendment Act, 1890, adopted. No action under the Dairies, Cowsheds, and Milkshops Order of 1885. No isolation hospital, and no disinfecting apparatus. Medical Officers of Health poorly remunerated.

2. BRYNMAWR (BRECKNOCKSHIRE); population (estimated), 6,500; Mr. T. W. Thompson.

Authority concerned: Brynmawr Urban District Council.

Ground of Inquiry: Prevalence of enteric fever; local information.

Chief Facts reported by Inspector: Enteric fever fatally present in the district during many years past. In 1895 there occurred 61 cases, in 47 houses, with 2 deaths, between August 8th and 29th The disease was apparently spread by the agency of water, two local wells being specially in question in this connexion; contamination of their contents by the specific material of fever possible and probable.

Sewerage by old brick barrel sewers and socketed stoneware pipes. Ventilation of sewers apparently inadequate. Some cottages without closet accommodation. Water supply from moorland gathering ground; works, completed in 1854, in hands of Urban District Council. Supply deficient in quantity in dry seasons. Local wells, in consequence, resorted to. No isolation hospital provided.

3. Carnarvonshire Combined District (including also parts of Anglesey, Denbigh, and Merioneth); population (1891), 164,255; Dr. Bruce Low.

Authorities concerned: Bangor and Beaumaris, Carnarvon, Conway, Festiniog, Llanrwst, and Pwllheli Rural; and Bangor, Bethesda, Carnarvon, Criccieth, Llandudno, Llanfairfechan, Penmaenmawr, Pwllheli, Ynyscynhaiarn, Colwyn Bay, Conway, Festiniog, and Menai Bridge Urban District Councils.

Ground of Inquiry: Board's desire for information as to sanitary progress and administration of the whole district.

Chief Facts reported by Inspector: Combination of 15 districts to appoint a Medical Officer of Health, formed in 1876; four additional urban districts joined combination voluntarily since then. Fair sanitary progress till recent years, when Medical Officer of Health's health gave way, and his annual reports became unsatisfactory. A deputy, appointed in 1893 with Board's sanction till expiry of Medical Officer of Health's period of appointment, in October 1895, has done good work. General results of inquiry adverse to breaking up of the combination. Sanitary progress and administration unequal. Urban authorities on the whole making progress; their water supplies and sewerage fairly satisfactory; slaughter-houses and common lodging-houses in certain instances in need of more attention; supervision of dairies, milkshops, and cowsheds, not always adequate. In rural districts administration lax, generally; water supplies sometimes scanty or liable to pollution. Removal of refuse occasionally very unsatisfactory, and provision for excrement disposal insufficient or defective. Only three (urban) districts have isolation hospitals. All constitutent authorities have adopted the Infectious Disease (Notification) Act, with four exceptions (two urban and two rural). In some instances remuneration of the Inspectors of Nuisances inadequate.

4. Chipping Wycombe (Bucks); population (1891), 13,435; Dr. S. W. Wheaton.

Authority concerned: Chipping Wycombe Town Council.

Ground of Inquiry: Repeated occurence of enteric fever in the district; report of Medical Officer of Health.

Chief Facts reported by Inspector: Enteric fever present in the district every year since 1886. In 1894 a widely-spread outbreak occurred, which was prolonged into the early months of 1895, and in which five deaths occurred. The actual number of attacks of fever not known, owing to absence of any provision for the notification of infectious disease in the district.

Impossible to fix upon any one of the many unwholesome conditions obtaining as having been especially concerned in spreading the fever.

Water supply principally from private wells, subject to pollution from leaking closet soil-pipes and defective house drains.

House drainage, frequently defective. Excrement disposal by means of hopper closets, without any separate supply of water for flushing purposes. No isolation hospital provision; no disinfection of infected houses, bedding, clothing, or drains, by the Town Council.

5. COWBRIDGE (GLAMORGANSHIRE); population (1891), 1,377; Dr. Bruce Low.

Authority concerned: Cowbridge Town Council.

Ground of Inquiry: Representations from the Glamorgan County Council under the Local Government (England and Wales) Act, 1888, to the effect that the Town Council had not properly enforced the Public Health Act.

Chief Facts reported by Inspector: Administration lax. Bye-laws not systematically observed. The Dairies, Cowsheds, and Milkshops Order of 1885 not enforced. Some defective cottage property possessed by the Corporation or by individual members of the Town Council. The town not sewered; some sewage passing by various channels to the River Thaw, which flows through the town; other sewage discharging into cesspools with pervious sides and bottoms. Some waterclosets, unprovided with flushing apparatus. A number of privy vaults allow of soakage of fluid filth into the adjacent soil. Water supply in a large measure from local shallow wells, all polluted or liable to pollution. One pump draws water from a spring outside the Borough; this supply inadequate for those wishing to use it, and inconveniently distant from many houses. A new water supply urgently needed for the town.

6. DEE RIVER WATERSHED; population (1891), 189,885; Dr. Bruce Low.

Authorities concerned: The Rural District Councils of Bala, Edeyrnion, Uwchaled, Llangollen, Chirk, Oswestry, Overton, Wrexham, Ruthin, Holywell, Hawarden, Tarvin, Malpas, and Chester.

The Urban District Councils of Bala, Llangollen, Wrexham, Mold, Whitchurch, Hoole, and Chester.

Ground of Inquiry: Alleged pollution of the River Dee, which serves as water supply for the city of Chester and adjacent places; local complaints.

Chief Facts reported by Inspector: A number of districts abutting on the Dee drain directly into it; others drain into it indirectly through tributary streams. Some districts above Chester treat their sewage at the outfall by subsidence in tanks, the effluent passing over land before discharging it into a stream; but even under the most favourable circumstances sewage is still liable to reach the Dee. Pollution of this river occurs also from discharge into it of waste chemical and other products. The Dee and its tributaries receive directly a large amount of human excrement from waterclosets and from privies erected on their banks. A large amount of

human excrement from cesspits and midden privies is spread upon land adjoining, and draining to the main stream or its feeders. The several streams are polluted by means of a considerable quantity of pigsty drainage. The impurities discharged into the Dee below Chester are carried up the stream by spring tides beyond the intake of the Chester Waterworks.

7. ENFIELD WORKHOUSE (MIDDLESEX); Dr. Copeman.

Authority concerned: Edmonton Board of Guardians.

Ground of Inquiry: Outbreak of Epidemic Skin Disease; report of Medical Officer of workhouse.

Chief Facts reported by Inspector: No special "infirmary" in connexion with this workhouse, all the inmates, 158 in number, being more or less infirm. Among these, 28 persons are known to have suffered from the disease between April 9th and May 24th, 1895. In addition, 14 others during this period suffered from constitutional symptoms similar to those witnessed in the 28 undoubted cases of the disease, but did not, at any period of their illness, exhibit a definite rash. Relation of malady to conditions of the milk supply indicated by facts, as follows:—In all, 92 persons, into whose diet milk, as such, entered, were each in receipt of a daily allowance of milk to the extent of one pint or more, and of these 92 persons 28 were attacked. Of the remaining 66 persons, making up with the 92 the total of 158 in the institution (excluding members of the staff), only two had an allowance of milk, and these two persons alone of the other inmates were affected. The first cases, moreover, appeared within about 10 days of a change in the milk service when the contract was taken over by a firm of contractors whose milk had previously fallen under suspicion under similar circumstances in certain other Poor-law institutions.

8. EXETER, CITY (DEVON); population (1891), 37,404; Dr. Fletcher.

Authority concerned: Exeter Town Council.

Ground of Inquiry: Neglect of Town Council to reply to numerous letters from the Board asking for information as to steps taken to carry out recommendations made in 1894 and previously.

Chief Facts reported by Inspector: Water supply taken from the Exe, a river seriously polluted with sewage from various places, especially from Tiverton. Filtering arrangements hardly satisfactory. All sewage from the city, where the water-carriage system is universal, discharged directly, or indirectly by way of leats, into the Exe. Construction of large intercepting sewer to convey the sewage into the tidal portion of the river contemplated. Much work of reconstruction of sewers and making of new sewers recently accomplished, and still going on. Large number of dilapidated and unwholesome dwellings crowded together in the older parts of the city. Byelaws as to new streets and buildings and as to slaughter-houses in need of revision, as also the regulations as to dairies, milkshops, and cowsheds. Unusual tenure of office by four Medical Officers of Health, not under the Board's Order. Improvements required with respect to the isolation hospital.

9. Flint (Flintshire); population (1891), 5,247; Dr. Reece

Authority concerned: Flint Town Council.

Ground of Inquiry: Diphtheria; Registrar-General's Returns.

Chief Facts reported by Inspector: In 1893, five cases of diphtheria notified, no deaths; in 1894, 46 cases notified, as due to diphtheria, diphtheritic croup, and diphtheritic sore throat—nine deaths. In 1895, 106 cases and 17 deaths to end of July. Disease spread by school attendance and personal infection. Schools not closed by Town Council, although this course was recommended by Medical Officer of Health.

A fatal form of "pneumonia" prevalent in 1895.

Infectious Disease (Notification) Act, 1889, and Infectious Disease (Prevention) Act, 1890, adopted. Isolation hospital accommodation meagre, and not used. No disinfecting apparatus. General disregard of sanitary precautions by the inhabitants.

No systematic sanitary records kept. Trade bad, poverty prevailing. Water supply scanty. Sewers fairly good, outfalls bad. House drains receive slop water from a few sinks without disconnexion in open air; most slop water thrown down gulleys in yards. Excrement disposal mostly by midden privies of bad construction. Scavenging inadequate. Ill-kept pigsties near houses. Dairies, Cowsheds, and Milkshops Order of 1885 not enforced.

10. Helmsley Rural District (Yorks, North Riding); population (1891), 5,626; Dr. Bruce Low.

Authority concerned: Helmsley Rural District Council.

Ground of Inquiry: Sudden outbreak of enteric fever; report of Medical Officer of Health, and local complaints.

Chief Facts reported by Inspector: A sudden outburst in August of enteric fever in the town of Helmsley, confined to customers of a particular milkseller, a member of whose family recovering from this fever came on a visit to the house from July 11th to August 24th. Two other cases of illness in August in milk vendor's family, one unnotified, the other certified as "relapsing fever." Sudden termination of outbreak in September on stoppage of sale of incriminated milk.

The District Council without hospital provision or proper apparatus for disinfecting clothing, &c. Sanitary administration lax. The Dairies, Cowsheds, and Milkshops Order of 1885 not enforced until after the epidemic had ceased. Sewerage of Helmsley defective; sewage discharged directly or indirectly into River Rye.

Outbreak of enteric fever in September, just after the Helmsley outburst, in certain riverside parishes below Helmsley: viz., Newton and Stonegrave in the Rural District of Helmsley; Nunnington in the Rural District of Kirkbymoorside; and Butterwick in the Malton Rural District. This outbreak confined to those persons who drank raw river water taken from the Rye at points below that at which it is polluted by

the sewage of Helmsley. Similar outbreak in places bordering the Rye in winter 1892–93 reported upon in Medical Officer's Annual Report to the Board for 1893–94, p. 89. Water supplies of all the riverside localities involved in the outbreak of September 1895 defective or inadequate. New sources of supply needed to prevent use of polluted river water.

11. Hetton-le-Hole and Brick Garth (Durham); Dr. Fletcher.

Authority concerned: Houghton-le-Spring Rural District Council.

Ground of Inquiry: Complaint by the Durham County Council of neglect on the part of the Houghton-le-Spring Rural Sanitary Authority to enforce the provisions of section 36 of the Public Health Act, 1875, relating to the provision of privy accommodation for houses.

Chief Facts reported by Inspector: One hundred and eighty-seven houses at Brick Garth unprovided (with the exception of a few wooden "sentry box" privies) with closet accommodation. Defective closet accommodation at Eppleton Row. Want of closet accommodation, and defective closets, at Cross Rows, Hetton. Owners in default, in not having provided the necessary closet accommodation, mainly, but by no means entirely, the Hetton Coal Company. Large sums of money spent of late, and much work is still being done by the Coal Company in repairing and rebuilding domestic premises.

12. Holbeach (Lincolnshire); population (1891), 4,771; Mr. Evan Evans.

Authority concerned: Holbeach Urban District Council.

Ground of Inquiry: Continued prevalence of diphtheria; Registrar-General's Returns, and local report.

Chief Facts reported by Inspector: Small outbreaks of diphtheria in surrounding districts during three previous years. First recognised case of diphtheria imported into Holbeach in January 1894, followed in March and April by seven other cases. Fresh outbreak in July persisting until March 1895. Total attacks, 67; deaths, 16. General prevalence of sore throat, more especially amongst children attending elementary schools. Disease spread mainly by personal infection.

Many dwellings damp and dilapidated. Absence of proper sewers. Excrement disposed of in privy pits. Scavenging not undertaken by Authority. Polluted water supply from shallow wells in the town. No hospital provision or disinfecting apparatus. Infectious Disease (Notification) Act, 1889, not adopted.

13. Llanfynydd (Carmarthenshire); population (1891), 949; Dr. Deane Sweeting.

Authority concerned: Llandilofawr Rural District Council.

Ground of Inquiry: Diphtheria; Registrar-General's Returns.

Chief Facts reported by Inspector: Considerable amount of fatal throat malady in Rural District during 15 years, usually not

designated diphtheria. Great increase of recognised diphtheria mortality in 1894, confined to the parish of Llanfynydd. Altogether some 50 cases of diphtheria in this parish between November 1894 and March 1895. Greater incidence and fatality on the village than on the outlying part of Llanfynydd. Outbreak preceded by cases of "bad cold" and hoarseness in school children.

Ventilation of the school inadequate. Damp houses, polluted water, and defective means of excrement and refuse disposal common throughout the place.

School closure and sulphur fumigation of houses the only steps taken. No isolation hospital. Nuisance abatement unsatisfactory.

14. LODDON (NORFOLK) ; population (1891), 1,169 ; Dr. Copeman.

Authority concerned: Loddon and Clavering Rural District Council.

Ground of Inquiry: Localised outbreak of enteric fever ; report of Medical Officer of Health.

Chief Facts reported by Inspector: No enteric fever in district for 10 years previous to outbreak in question. Disease introduced from Norwich by girl who had been in service at the Jenny Lind Infirmary, Norwich. Three members of her own family at Loddon first affected. Later, somewhat extensive outbreak in Loddon, apparently brought about by specific contamination of the town pump well. Thirty-two cases in all, with eight deaths. Four cases in adjoining villages, all in boys attending Loddon school, who used water from town pump.

No hospital provision, nor proper disinfecting apparatus, established by Rural District Council. Privy middens of large size universal, but no public scavenging. Water supply entirely from surface wells, and of bad quality. Lower part of town water-logged.

15. LYMPSHAM (SOMERSET); population (1891), 420; Mr. T. W. Thompson.

Authority concerned: Axbridge Rural District Council.

Ground of Inquiry: Alleged defective water supply: complaint from Somerset County Council under section 19, sub-section 2, Local Government (England and Wales) Act, 1888.

Chief Facts reported by Inspector: Parish of Lympsham very flat and intersected, for purposes of drainage, by numerous ditches or "rhynes." Subsoil, clay. Chief industry, dairy farming. Milk used for cheese making or distributed to large towns.

General sanitary arrangements of parish very unsatisfactory. Privy contents and slop sewage commonly discharged into ditches. Water supply mainly from dry-steined shallow wells, ponds, or ditches. Wells liable to pollution, and apt to fail in dry seasons ; certain parishioners habitually sending out of the parish—distances of two miles or more—for water;

others depending entirely on ponds, or on ditches obviously exposed to serious contamination. Water regarded as unfit for drinking purposes used at several farms for dairy operations.

16. PEMBROKE BOROUGH (PEMBROKESHIRE); population (1891), 14,978; Dr. Reece.

Authority concerned: Pembroke Town Council.

Ground of Inquiry: To ascertain the action taken for the sanitary improvement of the borough since the Board's Cholera Survey.

Chief Facts reported by Inspector: Borough comprises two wards, "Pembroke" and "Pater," which are practically two towns, and are known as "Pembroke" and "Pembroke Dock"; also it includes several villages. District, poor; much leasehold property held by small owners; leases to expire in about ten years. This fact urged by Town Council as reason for not undertaking large works of sanitary improvement. Water supply of both towns and villages deficient. Wells liable to pollution from various causes. No system of sewerage at either town. At Pembroke a few rubble drains, square in section, drain to the "Commons Lake," on the south, and to the Mill Pond on the north. A few old sewers at Pembroke Dock discharge on the foreshore of Milford Haven. House drainage scarcely existent in many parts of the borough. Excrement disposal and removal:—*Pembroke.*—By few w.-c.s, but mostly by midden privies; obligation of cleansing latter imposed on householders. *Pembroke Dock.*—By a very few w.-c.s, often discharging to badly-constructed cesspools; mostly by midden privies. Charges made by Town Council for cleaning out middens. Refuse disposed of on gardens; in Pembroke Dock Town Council also scavenge. Common lodging-houses not in good condition. Slaughter-houses unsatisfactory. Infectious Disease (Notification) Act, 1889, and Public Health Acts Amendment Act, 1890, not adopted. Byelaws not enforced, and in need of revision. Outlying villages generally in insanitary condition.

No vigorous action taken by Town Council to remedy existing evils.

17. PHILLACK (CORNWALL); population (1891), 4,009; Dr. R. J. Reece.

Authority concerned: Phillack Urban District Council.

Ground of Inquiry: Enteric fever; report by the Medical Officer of Health.

Chief Facts reported by Inspector: Of 25 houses in Caroline Row, 15 were invaded by typhoid fever, and of 117 inhabitants, 30 were attacked and four died. Other cases, one fatal, in Ventonleague Row, near at hand.

The houses in Caroline Row are damp, eavespouting absent in cases, several houses are practically back-to-back, some dirty, others very clean. Good garden space. Water supply of Caroline and Ventonleague Row from surface wells, mainly from one such well, liable to dangerous pollution. Open ash-

pits ; many mere holes in ground, boghole privies, not every house has separate privy accommodation. Scavenging done by occupiers. Slop water thrown in road or behind houses, whence it runs down slope and collects in pool near bottom house. Disinfectants supplied by the District Council, but disinfection left to occupiers. No disinfecting apparatus ; no isolation hospital. Infectious Disease (Notification) Act, 1889, not adopted.

18. POTTERSPURY (NORTHAMPTONSHIRE); population (1891), 1,037; Dr. Bulstrode.

Authority concerned: Potterspury Rural District Council.

Ground of Inquiry: Inspection by request of the District Council of the water supply of the village of Potterspury in connexion with an outbreak of enteric fever in that locality.

Chief Facts reported by Inspector: Water supply from shallow wells and other superficial sources liable to contamination. Excrement disposal by means of privy vaults so constructed and situated as to favour pollution of subsoil and of well water. In recent years exceptional incidence of enteric fever in the village of Potterspury greatly in excess of that on other villages of the district. Outbreak to which inquiries related commenced in July 1895 and was still continuing at date of report (November 1895). Evidence pointed to polluted well water as a very important factor in causation, though personal infection had probably considerable influence in the spread of the disease.

No isolation hospital accommodation.

19. QUARRY BANK (STAFFORDSHIRE); population (1891), 6,732; Dr. Wheaton.

Authority concerned: Quarry Bank Urban District Council.

Ground of Inquiry: Outbreak of "fever"; report of Medical Officer of Health.

Chief Facts reported by Inspector: Outbreak of enteric fever, almost entirely confined to a small portion of the district, and especially to one particular street. This marked localisation of the fever, and the fact that it had in some instances affected nearly all the members of certain families, suggested the presence of some fever (*e.g.*, typhus fever) more directly contagious from person to person than enteric fever. The fever in question found to be undoubtedly enteric fever. Owing to the multiplicity of unwholesome conditions difficulty in fixing upon any one condition as accounting for spread of the fever. Spread probably in part due to polluted water, partly to privies which had become infected, and to personal contagion.

The condition of the houses which had been invaded by fever unwholesome in almost every respect. Water supply, in most instances from draw wells, subject to pollution by leaking privies, defective drains, and by surface washings. Excrement disposal effected by midden privies of faulty construction and inefficiently scavenged. House drainage very defective, or

absent; sewage passing into roadside channels, and into watercourses. A certain proportion of the sufferers from fever removed to hospital, but no measures taken for providing pure water supply, for effective cleansing of privies, or for thorough disinfection of interiors of houses.

20. Raunds (Northamptonshire); estimated population (in 1895), 3,500; Dr. Bruce Low.

Authority concerned: Thrapston Rural District Council.

Ground of Inquiry: Prevalence of enteric fever; reports of Medical Officer of Health.

Chief Facts reported by Inspector: Sporadic cases of fever in first half of 1895, followed by epidemic outburst, August to December, comprising 129 notified cases with 12 deaths. Two distinct groups of cases; each group associated with use of water from a different public well that had become specifically polluted. The closing of these two wells, one after the other, followed by marked subsidence of outbreak. Raunds, situated upon porous soil, has no sewers; sewage finds its way to the brook which serves as a common sewer of the place and creates great nuisance. Excrement disposal by pail closets. House refuse, with pail contents, removed weekly by contractor. Sewerage scheme recently submitted to Board, but sanction withheld owing to defects in scheme. Water supply from local wells and springs, all more or less liable to pollution. A new public water supply and a sewerage scheme urgently needed for Raunds.

21. Sunderland Borough; population (1891), 131,015; Mr. T. W. Thompson.

Authority concerned: Sunderland Town Council.

Ground of Inquiry: Enteric fever; Registrar General's Returns.

Chief Facts reported by Inspector: Enteric fever in 1895 conspicuous by suddenness of its increase and pronounced localisation. The month of September furnished an eight-fold increase in the prevalence of the disease. This localised fever not to be thought of as arising from conditions of water supply, defective sewerage, or flooding. Midden privies in connexion with invaded houses of no more objectionable type than those generally distributed throughout the town. But the special localised increase of incidence to be regarded as due to the agency of a particular milk service.

22. Thurmaston (Leicestershire); population (1891), 1,681; Dr. Fletcher.

Authority concerned: Thurmaston Urban District Council.

Ground of Inquiry: Reports of successive Medical Officers of Health as to defects of sewerage, water supply, and as to pollution of canal and River Soar.

Chief Facts reported by Inspector: Water supply derived from numerous shallow wells, many of them liable to pollution from various sources. Leicester Corporation water mains within easy reach.

Sewerage of an unsatisfactory character; numerous catchpits in the course of sewers; no sufficient means of purifying sewage before passing it into the river and canal.
Excrement disposal mainly by means of various forms of privies, mostly constructed on bad models.
Scavenging fairly well performed by contract.
No "Adoptive Acts" in force. No isolation hospital. Byelaws in need of revision.

23. VALLEYS of the RIVERS RUMNEY, SIRHOWY, EBBW FAWR, EBBW FACH, MAIN EBBW, and AFON LLWYD (MONMOUTH and GLAMORGAN); population (1891), 175,432; Mr. T. W. Thompson.

Authorities concerned: Twenty-three Town, Urban, and Rural District Councils.

Ground of Inquiry: Desirability of ascertaining precise facts as to sewerage and drainage arrangements, and as to pollution of streams.

Chief Facts reported by Inspector: The rivers in question constitute the common sewers of the valleys through which they pass. With few exceptions the sanitary districts concerned discharge into these rivers, in large amounts, slop-sewage, excremental sewage, or sewage of both sorts. In addition, the rivers are subject to serious pollution by waste trade-products, and to some extent also by ashes and other refuse "tipped" upon their banks. Consequently these rivers are in an extremely foul condition, and are liable in hot weather to become very offensive, especially in their upper reaches, where in dry seasons they dwindle to insignificant streams.

24. WALWORTH (LONDON); Dr. Copeman.

Authority concerned: Newington Vestry.

Ground of Inquiry: Occurrence of a case of lead-poisoning in electric accumulator works; local report.

Chief Facts reported by Inspector: Works recently opened at Walworth, visited in conjunction with Medical Officer of Health for Newington district. Plate-making rooms the only part of works likely to cause lead-poisoning. Powdered litharge and red lead, used for making "plates," scattered over benches and floors. Carelessness as to precautionary measures on part of employés. On examination, foreman and a boy who had been in plate-room since opening of works showed symptoms of incipient lead-poisoning.
Manager has drawn up special regulations to be strictly enforced in the future.

25. WEST BROMWICH (STAFFORDSHIRE); population (1891), 59,474; Dr. Buchanan.

Authority concerned: West Bromwich Town Council.

Ground of Inquiry: Continued prevalence of enteric fever.

Chief Facts reported by Inspector : System of sewerage now completed, and, on the whole, satisfactory. Large unwholesome privy middens or privy vaults; comparatively few waterclosets, although sewers allow of water-carriage. Objectionable "tips" in borough for midden contents and other refuse. Many inhabited houses much dilapidated; yards commonly unpaved and faultily drained. Soakage from privy middens, and pollution of soil round houses. Houses damp. Authority slack to take adequate action in these matters. Borough byelaws under local Acts, especially building byelaws, insufficient. Existing byelaws not properly enforced. Common lodging-houses unsatisfactory. Dairies, cowsheds, and milk shops regulations neglected. Present staff of inspectors inadequate.

Isolation hospital used for scarlet fever and occasionally also for small-pox. No hospital accommodation provided for enteric fever patients.

Enteric fever unduly prevalent for some years, and increasing since 1893. Several different groups of houses in various parts of the borough heavily invaded in one or another year. In 1895 heavy incidence on three small areas widely separated one from another. Prevalence of enteric fever referred to the many opportunities of local spread from patients or invaded premises afforded by sanitary defects of the sort noted, and by want of isolation hospital accommodation.

26. WYCOMBE MARSH (BUCKS); population (estimated), 700; Dr. Buchanan.

Authority concerned: Wycombe Rural District Council.

Ground of Inquiry: Outbreak of enteric fever; report of Medical Officer of Health, and local complaints.

Chief Facts reported by Inspector: Recent sustained prevalence of enteric fever. A few cases every fortnight from October 1895 to January 1896. In all, 24 cases. No evidence of milk or food causation of the fever. No common sewer or public water supply in village. Water from numerous shallow wells in thin bed of alluvium overlying Chalk. Numerous cesspools in village. Outbreak not to be traced to water from any one well or group of wells, or to contamination of wells in different parts of village from any particular cesspool or cesspools. Indications of specific pollution of whole body of ground water, which supplies the wells of village. Village on alluvial plain between River Wye and "Back River." Ground water, which supplies its wells, has passed down valley between two streams. In so doing, 500 yards above Wycombe Marsh, it passes sewage farm of Chipping Wycombe. Sewage passes rapidly through this farm without efficient purification, and joins ground water beneath farm, which is passing to the village wells. Sewage which does not reach ground water in this way is discharged by under drains into "Back River," a stream largely augmented by sewage farm effluent. Tendency of "Back River" water at Wycombe Marsh to mingle with ground water beneath village.

App. A. No. 5.

Abstract of Medical Inspections.

Enteric fever prevalent in Chipping Wycombe in 1895. Exceptional circumstances — in the damming of the "Back River" just below Wycombe Marsh—just before the outbreak in the village tended to bring sewage of farm into closer relation than usual with village wells; (*a*) because, owing to new differences of level, contaminated ground water coming down from sewage farm was being thrust over more directly towards village wells; (*b*) because land between "Back River" and village was being flooded with sewage farm effluent, so that flood water could make its way directly to wells.

All existing shallow wells in Wycombe Marsh to be regarded as liable to dangerous pollution.

No. 6.

EXTRACTS from REPORT on the SANITARY CONDITION of the BOROUGH of CHIPPING WYCOMBE, and on PREVALENCE of ENTERIC FEVER in that URBAN DISTRICT; by Dr. S. W. WHEATON.

The attention of the Local Government Board having been directed to the repeated occurrence of enteric fever in High (Chipping or Chepping) Wycombe, and especially to a recent outbreak there of this disease in the autumn and winter of 1894, I was instructed to make inquiry into the sanitary condition of the town and into the circumstances with which the fever was associated.

The town of High Wycombe is situated in a narrow valley between steep hills of Chalk, and extends for a distance of about two miles along both sides of the main road from London to Oxford, which traverses the valley. The houses in the central parts of the town are old, and they are mostly occupied as private residences or shops. At each end of the town the houses are for the most part newly built, and are occupied by the artizan class. A great deal of building has gone on in these two localities recently, particularly at the north-western end of the town, where building operations have also extended for some distance up a narrow valley along the Hughenden Road.

The area of the borough is 687 acres; and its population in 1891 numbered 13,435 persons, living in 2,702 houses. The population has increased rapidly of late year. In 1881 there were 10,618 persons only, living in 2,168 houses; at the present time the population is estimated at about 14,500 persons.

The dwellings are principally built upon a bed of gravel which has been deposited in the valley, though some have been built upon a bed of peat. At each end of the town a number of houses are built directly upon the Chalk.

A small stream, the River Wye, runs through the town, almost parallel in its course to the main road. This stream is formed by springs issuing from the Chalk near West Wycombe, and is joined by several small tributaries as it passes through the town, finally falling into the Thames near Bourne End.

Water is found within a few feet of the surface in the bed of gravel upon which the town is mainly built. This water is making its way down the valley from the Chalk hills on each side.

The water supply is derived principally from wells; but the Wycombe Baths and Waterworks Company supply a certain number of houses in the district and neighbourhood. The wells are for the most part shallow, and are fitted with pumps.

* * * * *

Sewerage.—The town was sewered in 1882, according to a scheme prepared by Mr. Baldwin Latham. All the sewers are composed of stoneware pipes with the exception of a portion of the outfall sewer, which is of iron. There are sewers in all the principal streets, and the sewers have a good "fall" in most instances. The main sewer, which is 1 foot 6 inches in diameter, passes along the main street, and terminates at the south-eastern end of the town in an outfall sewer, which is 21 inches in diameter, and by which the sewage is conducted to the sewage farm, about half a mile distant from the town. At the sewage farm the sewage flows into eight settling tanks, from which the deposited sludge is drawn off, and after mixing with a preparation of alumino-ferric oxide in a sludge pit, is pumped on to the ground and

allowed to dry before being sold to farmers for use as manure. The liquid portion of the sewage flows directly on to the land of the sewage farm, some 12 acres in extent, which is under cultivation. Various crops are grown on plots of ground between the channels into which the sewage is allowed to flow. The effluent from the sewage farm is collected by deep drains, and discharged at several points into a small stream, which joins the River Wye some distance below the town. The sewers are ventilated by the manhole covers, which are provided with charcoal boxes, and are usually placed in the middle of the road. The flushing of the sewers is carried out by stopping the lower opening of the sewer into the manhole, and allowing the sewage to accumulate until there is sufficient to flush the length of sewer below on withdrawing the stop valve. The water of the Wycombe Waterworks Company is also used for flushing the sewers, and is conveyed to the manholes in water-carts for this purpose. There is always a large quantity of water flowing through the sewers. I am informed that water enters all the sewers from the surrounding subsoil, and in some places springs have gained access to the sewers. Although there is such a large quantity of water flowing through the sewers, there is a great tendency for them to become blocked by a thick lime-like deposit. This deposit forms a coating on the interior of the sewer, and appears to be due to chalk held in solution in the subsoil water, and precipitated when it meets with the sewage in the pipes.

House Drainage.—The house drains are in many instances of very faulty construction, and their joints are not cemented. When the sewers were constructed many of the old house drains were not relaid. The house drains are in many instances, in the case especially of dwellings which have been built during the last few years, ventilated by means of iron ventilating pipes; but these pipes are in most instances too small in diameter to be of much value as ventilators. The house drains, in the case of the older houses, are mostly unventilated. The sink pipes are usually disconnected from the drains, by being made to discharge over gulleys in the open air; but the junction of the sink pipe to the sink, and of the gulley to the drain, is often faulty. Of late more attention has been paid to house drainage, and the surveyor has required the drain joints to be cemented, and the drain rendered water-tight, in the case of new houses.

Excrement Disposal.— This is entirely effected by means of pan closets. These are of the old-fashioned "hopper" form, and are almost universally unprovided with a supply of water for flushing. In consequence of this absence of flushing, the pans of the closets are often found in a very filthy condition, particularly where one closet is used by several families in common, and where no one person is responsible for the carrying out of the flushing. Commonly the slop water, which might have been used for flushing the closet, is thrown down the sink pipe in the back kitchen, in preference to carrying it some distance to the closet. In some instances, also, where one well serves for a row of houses, it is situated at a long distance from some of them, and the labour of carrying water is so considerable that very little is used for the purpose of flushing the closets attached to such houses. The closets are, in the case of newly-built houses, usually situated immediately at the back of the dwelling; but in the older houses they are often situated some distance away, in sheds or other outbuildings, so that the drain leading from them has a long distance to traverse before joining the house drain by which it is connected to the sewer. From many of these closets a very foul effluvium is given off, which is perceptible at some

distance from them. Owing to the want of water for flushing, a deprivation which is in some instances aggravated by the great length of the closet drains, the latter frequently become obstructed, and require to be cleared out or taken up.

* * * * *

Enteric fever has not been absent from the district for many years, localised outbreaks of the disease having occurred every year since 1886. In 1894 an exceptionally widespread outbreak occurred, which was prolonged into into the early months of 1895, and from which five deaths resulted, the total number of attacks being estimated by the Medical Officer of Health, in a special report which he prepared on the subject in December 1894, as from 30 to 40. Later, however, in his annual report for 1894, he reported that the number of cases had been probably not far short of 50. Owing to the absence of any system of notification of infectious disease in the district, I found that it was impossible to ascertain the exact number of attacks which had occurred in a period extending from January 1894 to February 1895.

With regard to the causation of the fever in question, I visited a number of the houses in which attacks had occurred; but in the course of my inquiry it soon became evident that the unwholesome conditions existing at these houses were so numerous, and the possible sources of fever so many, that it was impossible to fix upon any single unwholesome condition as having given rise to the disease, or as having especially favoured its spread. Nevertheless, it deserves to be mentioned that an unwholesome condition, which was common to all the invaded households, was the want of a supply of water for flushing the closets.

Two instances may be given as illustrating the complexity of the problem, and the various ways in which it was possible that the disease had been set going, or had been communicated from one individual to another.

Nine attacks of enteric fever occurred in a house in Oxford Road. The first sufferer was a servant girl, who was taken ill with enteric fever in her employer's house, and was removed to this house in Oxford Road to be tended during her illness. The removal of this sufferer to the house was followed by the occurrence of eight further attacks of fever in the members of the household, in quick succession. When an examination of the premises was made, there was found to be ample cause for the spread of the fever in this household. The well here, which furnished the sole water supply, was situated within two yards of the closet, the soil pipe from which passed over the top of the well, which was covered in with brickwork. On examination of this soil pipe, it was found that it was not water-tight, and that filth escaping from it had percolated through the brickwork into the well. The closet at this house was of the "hopper" form, without any water supply. There were here at least three possible sources of the spread of the infection of enteric fever from the first sufferer. In the first place, the retention of sufferers from an infectious fever in a small house, which was quite unfitted for the purpose, and in which it was impossible to properly keep separate the diseased and the healthy members of the family, would greatly favour the spread of the fever by direct personal infection. In this connexion it may be mentioned that the mother of the family told me that at night time the whole house was pervaded by the smell from the evacuations of the sufferers. Secondly, the pollution of the water of the well by the discharges from a person affected by the fever would amply suffice to explain all the attacks

which occurred subsequently to the reception of the first sufferer, for the discharges from the first sufferer were, I found, thrown down the closet, and could thus find entry into the well from the leaking soil pipe. Thirdly, there was the possibility of infection directly from the use of a closet down which the excreta from a person suffering from enteric fever had been thrown; a closet which could not be properly flushed, owing to the want of a supply of water for this purpose.

Two fatal attacks of enteric fever occurred at a house in St. Mary's Street. The house is small, and an old one. The water supply is obtained from a shallow well. A closet is in use which is unprovided with a supply of water for flushing. The first sufferer was attacked in November 1894, and died on December 19th, 1894. The illness of this person followed a heavy fall of rain which occurred in the district in November last, by which water was forced up the manholes of the sewers in this part of the town, with the result that sewage was carried into many of the wells, including that of the house in question. Seeing that enteric fever had been prevalent in the town during the autumn of the year, it would have seemed highly probable that the infection in these two cases had been conveyed by the water from the well, which had become contaminated by sewage from sewers which had received the discharges from cases of fever in other parts of the town. There was, however, another equally probable cause of the origin of the fever in this household. The first sufferer was a teacher in the infants' department of the Central Board Schools, and two fellow teachers in the same department became affected by enteric fever at the same time. On inquiry it was found that the closets at this school were without a supply of water for flushing; they were flushed by hand only. It was also found that the drains were in a very defective condition, that the sink pipes from the school lavatory were untrapped, and that they communicated directly with the drains; also it was found that the ventilating shafts in connexion with these drains were blocked up, so that foul air from the drains would enter the lavatory through the untrapped sink pipes. With regard to the second attack of fever at this house, the subject was a brother of the last-mentioned sufferer, and there were many ways in which he might have contracted the infection from her. His fever might have been contracted by personal infection, the house being a small and old one, and totally unsuitable for dealing with a case of infectious disease. Infection in this instance might also have been contracted from the use of the closet, down which the evacuations of the first sufferer had been thrown, and which was without a supply of water for flushing; and, lastly, the infection might have been contracted from the use of the water from the well, which had been within a recent time contaminated by sewage.

The above two examples illustrate the many possible sources of enteric fever in this district, and also the many ways in which the infection of enteric fever might have spread there, owing to the absence of notification of infectious illness, to the want of isolation provision for sufferers from such illness, and to the absence of any disinfection of houses, drains, bedding, or clothing by the Town Council.

No. 7.

REPORT on an OUTBREAK of ENTERIC FEVER in the VILLAGE of WYCOMBE MARSH; by Dr. G. S. BUCHANAN.

The occurrence of a number of cases of enteric fever in the village of Wycombe Marsh, in the Wycombe Rural District, during the latter months of 1895 having been reported to the Board, I received instructions to make inquiry into the outbreak.

Wycombe Marsh is a village in the valley of the Wye, a river which flows in a south-easterly direction through the chalk hills of Buckinghamshire to join the Thames near Bourne End. The village is situated about 6 miles up the valley from the Thames, and stands some 180 feet above Ordnance Datum. Two miles higher up the stream is the Borough of Chipping Wycombe. The bed of the valley is a level plain which, near Wycombe Marsh, is nearly a quarter of a mile in breadth. It is bordered by undulating chalk slopes. The soil of the plain is porous, being composed largely of a fine gravel, estimated to average some 15 feet in thickness. It rests directly upon flinty chalk beneath. This alluvial plain is watered by two streams, the River Wye and the "Back River," which flow in a direction generally parallel to each other on either side of the valley, and are fed by numerous springs which arise in the plain at the base of the chalk hills.

The village of Wycombe Marsh consists of an irregular cluster of houses, which lies on this plain between the two streams. The main road from London to Chipping Wycombe passes by the village on the other side of the River Wye. Along the chalk slope to the north of this road, as it runs between Wycombe Marsh and Chipping Wycombe, houses have been recently built, and some 40 of these are now usually reckoned as comprised in Wycombe Marsh. Their inhabitants, however, find their work in Chipping Wycombe, and have little to do with the village proper. Excluding these houses, there are some 140 dwellings in the village, and an approximate population of 700 persons. Some of the inhabitants are agricultural labourers, some are engaged in sundry small trades, while others are employed at paper or flour mills in the neighbourhood.

The houses of Wycombe Marsh, built in irregular rows along the several roads in the village, are small, and usually they are constructed of brick, or of brick and flint. They appear fairly well built for dwellings of their class, but their walls are damp in almost every case. Each house, or group of houses, has a small garden attached. In most of the houses there is a sink, which discharges to a gully outside. From the gully a drain takes the slop water to a covered and unventilated cesspool. Where there is no drain waste water is thrown directly on to the garden. Most of the dwellings are provided with privies, which in some cases are furnished with pits below the ground level, and in others are supplied with pails placed beneath the seat. Excreta collected in these receptacles are dug into gardens, taken to allotments, or otherwise disposed of by the occupiers of the houses. Dry refuse is usually allowed to accumulate in an open heap, and is then dealt with

in the same manner. In some rows of houses a closet of the "hopper" type is attached to each house. These closets are unprovided with means for flushing. They are usually connected with a cesspool which receives the contents of all the closets of the row. The cesspools of the village, whether for slop water or for excreta, are commonly placed in the gardens. Although they are seldom emptied, they do not often overflow, probably because their structure allows of rapid percolation of their liquid contents into the soil. The water supply of each house or group of houses is obtained from a well or wells, usually a dip-well, in the garden, and in proximity to the cesspool. Some premises possess "tube wells," which have been driven, as a rule, from 10 to 15 feet into the earth. The steining of the shallow wells, usually of brick or flint, permits water to pass readily through it. Throughout the village the level of the ground water is high; in some wells water is reached within 3 feet, and in almost all within 6 feet, of the surface.

At the outset of my inquiry, some little difficulty arose in determining how many persons in the village had been attacked by enteric fever during the outbreak. Notification of infectious sickness is not compulsory in the Wycombe Rural District. From information obtained from the Medical Officer of Health, Dr. Dickson, and from that supplied to me by the Rev. C. Dowding, curate of St. Anne's-in-the-Marsh, I gathered that 24 cases had occurred in the village, two of which had already proved fatal, among the inmates of 19 houses. In addition to these, I heard of certain children who had suffered from sickness of two or three weeks' duration, not definitely diagnosed as enteric fever.

Owing to the absence of precise record of the fever cases, I found it impossible to determine with exactness the date of onset of sickness in any persons but those most recently attacked. It appeared that there had been no general outburst of the disease at any one time, but that cases had continued to occur at intervals since September. The two earliest cases I heard of seem both to have sickened with fever in the last week of that month, and the number of persons attacked in each subsequent fortnight appears to have been as follows:—

Fortnight	ending	October	14th	2
"	"	"	28th	3
"	"	November	11th	5
"	"	"	25th	4
"	"	December	9th	4
"	"	"	23rd	2
"	"	January	6th	2

Of the 24 cases 10 were males and 14 females. Five of the 24 were children under the age of 12.

All the cases had, of necessity, been treated at their homes, as no provision has been made by the Wycombe Rural District Council for isolation and treatment in hospital of persons suffering from infectious sickness. The District Council had not, I found, taken any noteworthy steps in repression of the outbreak, although a sub-committee had been appointed to consider the prevalence of fever in the village.

The sub-committee had received reports from the Medical Officer of Health, and had made certain inquiries. At each invaded house instructions had been given to the inmates by the officers of the District Council as to the disposal of excreta and as regards other matters.

I made particular inquiry as to the history and circumstances of each of the 24 persons attacked. As might have been expected from consideration of their age and sex, those attacked did not follow any one particular occupation, nor, in the majority of cases, could I learn of communication of a sort to convey infection between the person or persons attacked in one house and those attacked in another. As regards milk supply, I found that the occupiers of two invaded houses, situated on the High Road to Chipping Wycombe, received milk from a dairy in that town. The remaining invaded households got milk from one or other of two cowkeepers, L. and W., who, living in Wycombe Marsh, between them supply most houses in the village. In both L.'s and W.'s household some member or members had been attacked by enteric fever. But I found that the first case in L.'s house had not occurred until late in October, and the first case in W.'s house not until the beginning of December, these cases being thus part of, and not antecedent to, the general prevalence of the fever. In two of eight invaded houses supplied by L., and in five of nine invaded houses supplied by W., enteric fever made its appearance before any member of the cowkeeper's family had been attacked. Enteric fever had not occurred among those customers of either cowkeeper who lived outside the village. Moreover there had been at no time a sudden outburst of cases such as infected milk usually produces. I could not learn of any other article of food that had been consumed alike by all the persons attacked.* And, as has been indicated, there is no public water supply or common sewer in the village.

The situation of the 19 houses invaded is indicated on the appended plan. Three of them are separated from the main part of the village by the River Wye. In one, just opposite Marsh Mill, a domestic servant fell ill at the end of October, and went to her home in Oxford, where her illness was recognised as enteric fever. I was informed that she used to visit at various houses in the village, but could obtain no details as to her case. The other two houses on the north of the Wye are situated some little way from the village, in the direction of Chipping Wycombe. Both are houses of the better class.† The remaining houses

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* In view of an opportunity of pollution observed in a certain cress bed near the village, I inquired as to consumption of watercress by those attacked, but with like results.

† A boy in one of these houses and a woman in the other fell ill with enteric fever in November. I was unable to trace any condition which was common to these two cases and to other fever cases in the village proper. The milk, food, and water supplies of the two households had nothing in common with those of Wycombe Marsh; the houses stood at a higher elevation and on different soil, and their inhabitants appeared to have communication rather with the town of Chipping Wycombe than with the village. In the absence of any demonstrable connexion between these cases and those attacked in Wycombe Marsh, I do not propose to consider them further. It will be observed that as both cases were attacked in November, neither can be thought of as conducing to the general outbreak of the village.

App. A. No. 7.
On Enteric Fever at Wycombe Marsh; by Dr. Buchanan.

invaded lie in various parts of the village between the two streams. The premises here had the character which I have described as common in Wycombe Marsh generally. Excreta were for the most part disposed of in privies; the majority of houses got rid of their liquid refuse in cesspools, but the household slops of others were thrown on to the gardens. As regards water supply, sometimes a shallow well and sometimes a "tube well" furnished the invaded house with water. Two families "dipped" their drinking water from a runnel which rises in a spring by the side of the "Back River," passes along the south-western side of the village, and enters the "Back River" below Beech Mill. As this runnel enters the village it passes in front of a house where cases of enteric fever have occurred; in its further course it runs within a few feet of the back of a row of 10 cottages called "Nottingham's Row," in four of which six persons were attacked by fever. Locally, it was considered that the water of the runnel might have been rendered infectious by slops which had been thrown into it when there was fever in the first house, and that the exceptional amount of fever in Nottingham's Row came about because those attacked there had drunk water that came either direct from the runnel or from shallow wells in its immediate vicinity. I found, however, that the earliest case of enteric fever which could be heard of in houses highest up this streamlet occurred at the beginning of November, by which time three cases had already occurred in Nottingham's Row. Moreover, persons in the village attacked by enteric fever who lived elsewhere than in Nottingham's Row gave no history of ever having drunk water obtained from this runnel.

In short, there was no indication that any considerable number of the persons attacked by fever had consumed water from this watercourse; nor did it appear that other invaded families had resorted to any one well or other particular source of water supply. Certain facts of the outbreak, however, its duration, the small but nearly constant number of those attacked fortnight after fortnight, and the distribution of the invaded houses throughout the village, were not inconsistent with the existence of a source of infection of wells generally by means of the ground water which passes through all the wells of the village.

It thus became of interest to obtain some idea of the direction in which the ground water moves in this locality, and to determine what opportunities of contamination presented themselves in its course.

In the narrow alluvial plain I have spoken of, the ground is saturated with water, often to within a very short distance of its surface, as witnessed by the springs which arise in the plain and the level of the water in the surface wells. As in other valleys, there is a general downward movement of soil water in the trough of the valley in a direction more or less parallel to the river, and here the porous character of the soil allows this movement to be comparatively rapid. In the part of the Wye Valley under consideration, however, there are, as has been said, two streams—the River Wye and the "Back River"—and the exact direction of flow of ground water at any one point of the interval between them is considerably influenced by the relation which there exists between the water level of one stream and that of the other.

Both the Wye and the "Back River" have several mills in their course, which so affect the streams that in different parts of the valley the water now of one and now of the other is at the higher level. At the points marked C and D on the plan the water level is nearly the same in the two streams. Below the point C, just before it reaches Wycombe Marsh, the River Wye falls 6 feet or more over a weir at Marsh Mill. The "Back River," below the point D, does not fall until it reaches the weir of Beech Mill, having then passed by the village. Owing mainly to the presence of these mills, the level of the water in the "Back River" on the one side of the village is higher by some 6 feet or more than that of the Wye on the other. This difference of level is in part maintained by an artificial embankment, about 3 feet in height, along the side of the "Back River" nearest the village, but is also brought about by the lie of the land in this situation. The surface of the plain has a gentle slope in a direction obliquely across the valley; the direction of the slope being, approximately, from west to east, as will be seen by the levels between one stream and the other marked on the appended plan.

Having regard to these facts, it may be taken that the soil water as it moves down the valley between the two streams will, as it approaches the village of Wycombe Marsh, tend also to move laterally, in a direction nearly corresponding to the slope of the surface, away from the higher level of the "Back River" above Beech Mill towards the lower level in the River Wye below Marsh Mill. Thus a particular agency of pollution of the ground water which could generally affect the shallow wells of the village would have to be sought for in the land of the plain above the village, and more particularly on that side of the plain towards the "Back River."

Upon this view certain dwellings in the valley above Wycombe Marsh, situated on the plain between the two streams, first came under suspicion. These houses, nine in number, are supplied with water from tube wells and have ceespools, some of which are in connexion with closets. But on inquiry at each of these houses I could not learn that enteric fever had occurred in any one of them in 1895, although I gathered that one or more inmates of most of the houses had been attacked by enteric fever in preceding years.

Next I gave attention to the sewage farm of the Borough of Chipping Wycombe, which is situated on both sides of the "Back River," about 500 yards from the nearest point of Wycombe Marsh. This farm has an area of 12 acres, of which about two thirds lie on the left bank and one third on the right hand of the "Back River." Having regard to the situation of this farm, I made some detailed inquiries with regard to it.

The surface water from the roads and streets of Chipping Wycombe is, I found, discharged by a separate drainage system into the River Wye within the borough; while the rainwater from the back premises of houses, and the household sewage, including that from the water-closets, are received into a system of sewers which lead by gravitation to the sewage farm. The average daily amount of sewage discharged

App. A. No. 7.

On Sewage Farm at Wycombe Marsh, by Dr. Buchanan.

by the main sewer on to the farm is reckoned as some 2,000,000 gallons; a quantity unusually large for the population of the borough, which is estimated at 15,000. This excessive quantity is no doubt due to the entry of soil water into the sewers at different points along their course. At the farm, the sewage, after passing through certain screening tanks,* irrigates the land now on one and now on the other side of the stream, as occasion requires. Along the boundary of the farm on either side a main channel conveys the sewage from the screening tanks. From each main channel subsidiary channels or "carriers" pass at intervals across the land of the farm towards the central stream, and end blindly within a few feet of its bank. The land between two adjacent carriers forms a level irrigation plot, usually some 20 yards or more in breadth. An under-drain lies parallel to the carriers below the centre of each plot so formed, and is placed 4 or 5 feet from the surface. The openings of the under-drains into the "Back River" are to be seen on either bank of the stream, the bed of which is here considerably below the surface level of the farm. The soil of the farm consists of about a foot of loam overlying porous alluvial gravel. One acre, or a little more, is usually under irrigation at any one time. Irrigation is effected by letting the sewage flow down a carrier until it overflows the plots on either side, and stands upon them to a depth of 2 or 3 inches—a result usually obtained when all the sewage discharged on the farm has been running over a single acre for about 12 hours. Owing to the large volume of sewage to be dealt with at the farm, steps have been taken in recent years to secure a rapid flow through the under-drains, in order to prevent the sewage accumulated on the land from overflowing directly into the stream. When I saw the farm the under-drains of the plots then being irrigated were pouring their contents rapidly into the river. The under-drains of the rest of the farm were practically dry, except those of certain plots from which sewage had been turned off about five hours previously. There was still some effluent from these drains, though much smaller in amount than the effluent from the plots then being flooded.

Before it reaches the sewage farm, the "Back River" is merely a small stream fed by several springs in its course down the valley, and by the overflow from a long narrow pond called "The Pool" in Lord Carrington's park, near Wycombe. This overflow is at times prevented from reaching the river by a dam at Marsh Green Mill. At the time of my visit the "Back River" was receiving the overflow, but even under these circumstances the volume of water in the river before its arrival at the farm appeared to be scarcely more than half that exhibited by this stream as soon as it had passed the farm, the difference being almost wholly made up by "effluent" sewage. The miller at Beech Mill, situated on the "Back River," just below Wycombe Marsh, told me that before the establishment of the sewage farm increased the

* There are two tanks on the farm, originally designed for chemical treatment of the sewage. Owing to the large volume of sewage to be treated, the use of chemicals has been abandoned, and the tanks now serve for little else than to screen off coarser matters brought down by the sewer.

volume of water in the stream, it had frequently been impossible to obtain enough water for working the mill, whereas now no difficulty is experienced in this respect.

The sewage farm lies, as has been said, some 500 yards above the village of Wycombe Marsh, and it seems certain that the drainage of the farm in part contributes to the ground water which supplies the shallow wells of the village. For when the contents of the main outfall sewer are being run over a comparatively small irrigation area in the way I have described, it is not to be expected that all the sewage will pass from the land by way of the under-drains. A portion, and probably a considerable portion, sinks at once below the level of the under-drains, and mixes with the ground water beneath. The body of the ground water below the farm is limited in depth on account of the comparative shallowness of the pervious soil which contains it; it has a rapid flow; and the direction of the flow is down the valley from the farm to the village. Moreover, there are further means by which effluent matters from the farm may gain access to the ground water in the soil beneath Wycombe Marsh. The "Back River," a large part of the contents of which is sewage farm effluent, flows little more than 100 yards from the village. Owing to the difference of level between the "Back River" and the Wye in this situation, the former tends to lose a portion of the water flowing in it by percolation into the soil, and soil water augmented in this way by "Back River" water would tend to flow, for reasons I have already indicated, directly beneath the village, to find a lower level in the River Wye below Marsh Mill. As a matter of fact, when the "Back River" has been observed to rise to a higher level than usual, the water level in certain shallow wells in the village has similarly been observed to rise; and this serves to illustrate the close relation which here exists between the "Back River" and the ground water of Wycombe Marsh.

Seeing that in one or other, or both, of these ways, effluent matters from the sewage farm can gain access to the ground water flowing to Wycombe Marsh, it is sufficient to note that the conditions of sewage treatment already described are clearly not conditions which offer any surety that pathogenic organisms originally present in the Chipping Wycombe sewage would be destroyed in their passage through the farm.* Given, for example, infectious matter from enteric fever patients introduced into the sewers of Chipping Wycombe, it has opportunities of passing undestroyed through the farm, of reaching the soil water, and of being carried with this water to the wells of Wycombe Marsh; whether gaining access to the soil water on the farm itself, or percolating from the "Back River" as it passes the village. In these circumstances, I had to consider what might have been the relation of the present outbreak in the village to antecedent fever in the Borough of Chipping Wycombe. Accordingly I inquired of the Medical Officer of Health of Chipping Wycombe, Dr. Ruckley, as to enteric fever in the Borough in 1895.

He informed me that, as far as he was able to judge from his own private cases, and from what he had heard from other medical men in the town, enteric fever had shown considerable prevalence. Six deaths were certified to be due to enteric fever in the Borough in 1895, as against four in 1894 and none in 1893. It had been estimated that 50

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* I am informed that, judging merely from chemical analysis, the effluent from this farm has been objected to by the Thames Conservators on more than one occasion in 1895.

persons were attacked by enteric fever in 1894—a prevalence of the disease in the district dealt with by Dr. Wheaton* in his report to the Board on the sanitary condition of the Borough—and Dr. Ruckley believed that the number attacked in 1895 had been still greater, although in the absence of returns of notified cases of infectious sickness he had no exact information on the subject. The facts were sufficient to show, however, that in 1895 there were many places in Chipping Wycombe where infectious matter from enteric fever patients had been discharged into the sewers of the Borough

This being so, it was not to be denied that the present outbreak in Wycombe Marsh might be referable to infectious matter, derived from antecedent cases of fever in Chipping Wycombe, which had reached the village through the operations of the Borough sewage works.

But in such a view of the 1895 outbreak, it was to be expected that the enteric fever prevalent in the Borough in the previous year (1894), which also brought about discharge of infectious matter from the fever cases into the town sewers, would similarly have occasioned an outbreak of fever in Wycombe Marsh. On inquiry, however, I found that only three or four persons in the village had been attacked by enteric fever in 1894. Thus, before the sewage farm could be thought of as a principal factor of the present outbreak, the following question had to be answered: Given enteric fever in the Borough in 1894 and 1895, why had Wycombe Marsh escaped with only a few cases in the first year, and suffered so heavily in the second?

The answer will be found, I believe, in a consideration of certain exceptional circumstances which have yet to be noted.

It will be seen from the plan that the "Back River" below the sewage farm, after flowing beneath a road which leads to Wycombe Marsh from the west, passes by the south of the village, and supplies Beech Mill. From the road to Beech Mill the stream is separated from the village by a pasture field, and its embankment rises some 3 feet above the level of this meadow. Before leaving the field, the "Back River" falls over a weir formed by a mill-dam. Up to September 1895 Beech Mill had been disused for some years. When it was disused, the upper part of the mill-dam was removed, and the water in the "Back River" was able to flow away readily. When the mill was set to work in September the height of the mill-dam was increased, so as to dam the water in the stream back into the mill pond. I have already pointed out that, at Wycombe Marsh, the course taken by the soil water, as it passes down the valley from the sewage farm, does not appear to be in a direction parallel to the "Back River"; rather its movement is obliquely from the "Back River" across the valley (and so beneath the village) towards the lower water level in the River Wye. Damming the "Back River" brought about a greater difference of level between the two streams, and thus tended to increase deflection towards the Wye of the ground water passing down the valley. In consequence, soil water passing down the valley from the sewage farm, and reaching the interval between the "Back River" and the village, would now be thrust over towards the village wells to a greater extent than had previously been the case.

And a further result of the damming of the stream has to be noted. Some months before the mill-dam was raised, the embankment of the "Back River" above it had been broken in certain places, and the extra height now given to the stream brought about a considerable overflow at these places into the field between this river and the village.

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* *See* App. A. No. 6 to this volume.

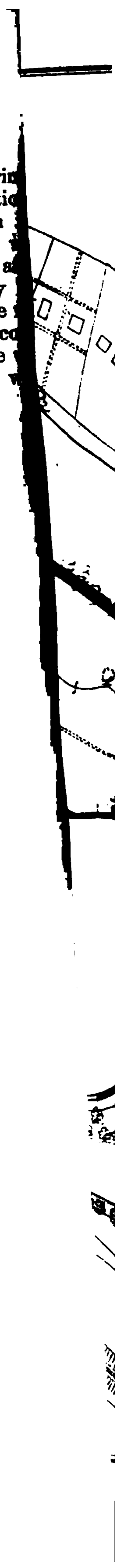
For some weeks nearly the whole of this meadow was under water. The flood did not make its way into the village itself on account of the rapidity with which the water sank through the porous soil of the field. Although some repairs were done to the embankment, the overflow appears to have continued in greater or less amount up to the end of December. At the time of my visit in January, small gaps were yet to be seen in places along the bank, from which water was flowing from the river on to the meadow, there soaking into the ground within a few yards of the gaps. As it sank below the surface of the field, the flood water would at once have mingled with the ground water beneath, which is here, for reasons I have noted, flowing directly towards Wycombe Marsh. The direction of flow was indeed indicated by patches of bright green grass which were to be seen leading from the gaps in the river bank across the meadow to the village in the direction marked by the arrows on the plan.

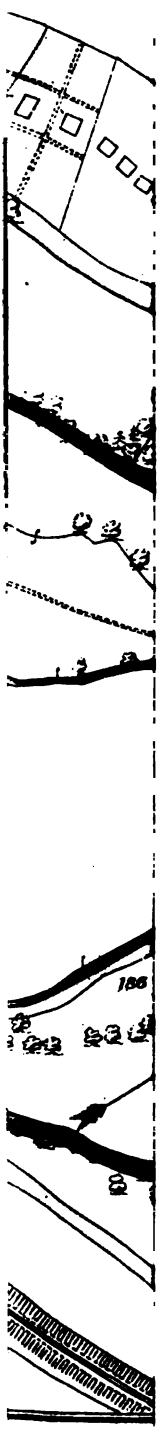
It thus appeared that, antecedent to and throughout the whole time that enteric fever was prevalent in Wycombe Marsh in 1895, admixture of matters from Chipping Wycombe sewage farm and the water supplying the wells of the village had become exceptionally intimate; not only because—from the raising of the dam at Beech Mill—a larger proportion than before of soil water from the sewage farm passed beneath the village on the marsh, but also owing to a direct passage of river water containing sewage farm effluent through the broken embankment, and by way of the flooded field, to join the soil water beneath the village. In this connexion it is noteworthy that the first six houses in Wycombe Marsh to be invaded by enteric fever (including those of Nottingham's Row, already referred to), were situated on its south-western border; on the side, that is, which is first reached by soil water from the sewage farm, and which is also that part of the village nearest to the field flooded in the way indicated.

If it should be asked why the outbreak of fever in this village is referred to specific pollution of soil water by Wycombe sewage, not to like pollution of it through the medium of the numerous and dangerous cesspools such as I have described as existing within the village itself, the reply would appear to be somewhat as follows:—Assuming specific pollution, antecedent to the outbreak, of one or more cesspools within the village, and consequently of the well or wells in relation thereto, it was to be expected that persons consuming water from such given well or wells would have suffered earlier and more heavily than their neighbours. But I could not discover any likely source of specific pollution of any particular village cesspool or cesspools under conditions that would, in any satisfactory manner, account for the outbreak, nor was there observed, at any rate in the beginning of the fever prevalence, any grouping of cases at Wycombe Marsh of the sort indicated. The first six cases occurred in six separate households on the western and southern confines of the village; and the water supplies of the dwellings hereabouts are so situated as to be practically secure from foul matter escaping from local cesspools, while they are exposed, beyond all others in the place, to deleterious matters passing with the ground water through the soil intervening between the village and the sewage farm, or passing out of the "Back River" on to and through the ground separating this river and the village.

I would here note that in December samples of water taken from two open and two "tube" wells in the village were sent for analysis to the public analyst of the county of Buckingham, who reported, in regard of each sample, that there was no indication of "sewage pollution," and

stated that, in his opinion, each water "is of good quality for dri and household use." But since many sources of sewage polluti these and other wells in the village are to be found (and with trouble in the seeking), the inferences I have drawn as to causation of the outbreak of enteric fever at Wycombe Marsh a no way invalidated by this testimony of the chemical purity particular moment of samples of water derived from certain of the of the village. Obviously, having regard to the facts I have rec respecting the conditions of water supply of Wycombe Marsh, the there must be regarded as liable at one or another time to yield dangerous to the health of persons consuming it.





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No. 8.

REPORT on an OUTBREAK of ENTERIC FEVER at LODDON, in the RURAL DISTRICT of LODDON and CLAVERING; by Dr. S. MONCKTON COPEMAN.

APP. A. No. 8.

On Enteric Fever at Loddon; by Dr. Copeman.

Loddon is a small town of about 1,100 inhabitants, situated in the South-East of the County of Norfolk on the River Chet. The greater portion of the town, consisting for the most part of houses abutting on the main street, is built on ground which rises gradually from the level of the river to somewhat higher ground on the South. At about the highest point of the town is the "Green," an expanse of grass used as a general playground. This is bounded on the west by the main street, and on the east by the churchyard. In the centre stands the town pump, to which reference will be made later on in this report.

The subsoil consists of the Norwich Crag, which is composed for the most part of gravel and sand.

Water Supply.—Drinking water is entirely obtained from surface wells, of which there are from 60 to 70 in the town. In the majority of these the depth of water does not exceed 4 feet. The water of the wells in that part of the town which lies between the Green and the river, appears to be of universally bad quality, owing probably in a large measure to long-continued contamination of the subsoil in that part of the town most remote from the river; and to the south of the Green the water, which in like manner is obtained from surface wells, appears, as far as can be gathered from the simple tests that have been employed, to be of somewhat better quality than is the case in the northern portion of the town. But not only is the quality of the water generally bad, but the quantity is apt to be decidedly insufficient for the wants of the inhabitants, especially in times of drought. At the time of my visit I was informed that previously to the outbreak of enteric fever, which forms the subject of this report, the water of the so-called "town pump," which is situated almost in the centre of the Green, had been in great request, and persons had been accustomed to resort to it for their water supply, even though living at some considerable distance from it. This was so, as I was informed, for the reason that the water obtained from this well was believed by the inhabitants to be of specially good quality. Since the first week in May 1895, however, the town pump has been chained up for reasons stated later on in this report. At about the same time a pump in Campbell's yard, near the Green and the old Market Place, was also closed by order of the Authority.

Drainage and Refuse Disposal.—There are two main drains in the town, one of which, starting from the Green at a point opposite the town pump, passes along the main road to discharge into the river at a point just underneath the bridge; the other starts from the old Market Place, and from this point pursues a course more or less parallel with the main street, but to the east of it. This drain opens into a ditch which is also

in communication with the river. These two drains, which receive household slops and rain water at various points along their course, are in parts composed of rubble and believed to be badly laid. This was certainly so as far as the drain leading from the Market Place was concerned, as owing to the suspicion that such was the case it was opened out by order of the Authority at the commencement of the recent outbreak of enteric fever. When this was done it was found that several tributary drains from houses in the vicinity of the Green were completely blocked, so that even liquid material could only find its way through exceedingly slowly. Of the houses here referred to, two were those occupied by families which were the first to be invaded by the disease. These tributary drains as well as a greater part of the Market Place main drain have since been taken up and replaced with new glazed and properly socketted pipes. This main drain has also been carried to a point nearer to the river, where it now discharges into a catchpit, the overflow from which passes in turn into the ditch and so to the river as previously described.

With respect to the drain passing down the main street, nothing has been done except that a gulley intended for the reception of waste water from the town pump has been led into it by the side of the town Green.

There are no waterclosets in the town except in one or two of the larger houses. Where these exist they discharge to cesspools, which are believed to overflow into the drain which passes down the main street. Most of the houses, on the other hand, are provided with privy middens, some of large size and of considerable depth. These all drain into the subsoil, or into channels communicating with numerous dykes with which the lowermost portions of the town are intersected, and which themselves discharge into the river, although the rate of flow of water through them is so slow that many are in consequence in an extremely foul condition. The privy middens, which also for the most part receive all household refuse, such as potato peelings and the like, are supposed to be emptied as occasion requires by the householders, and their contents disposed of on allotments or farm land in the neighbourhood of the town. Not unnaturally, perhaps, the emptying of these receptacles is postponed as long as possible, thereby affording all the more opportunity for contamination of the subsoil in their neighbourhood.

History of the Outbreak.

From information which I received from the local medical men, it would appear that prior to 1895 Loddon had been entirely free from enteric fever for the last ten years.

The first person to suffer attack during the outbreak of the present year was a girl aged 15 years named Pamela B——, who from August 1894 until February 1895, had been in service as under-housemaid at the Jenny Lind Infirmary at Norwich. She had always been somewhat weakly, and as she appeared to find her work too much for her strength

she was examined medically by Dr. Burton-Fanning, the physician to the Infirmary, in December 1894. He then found that she was suffering from mitral stenosis, but her condition improved somewhat with rest. At the commencement of February of the present year, however, as she complained of constant headache, she was advised to give up service and return to her home at Loddon. This she did, arriving there on February 6th. Four days later, on February 10th, she was seen by Mr. Prior who found that she was suffering from a sore throat; but when again called in on February 18th, he came to the conclusion that the case was undoubtedly one of enteric fever.

Under these circumstances, I took occasion, during the progress of my investigation, to visit the Jenny Lind Infirmary at Norwich and to confer there with Dr. Burton Fanning, in order to ascertain, if possible, in what manner Pamela B——— had contracted the disease, the incubation period of which had probably commenced previously to her return to Loddon. In answer to my inquiries, Dr. Burton-Fanning informed me that although patients suffering from enteric fever are not ordinarily received into the institution from outside, three of the nurses had been attacked with the disease in January and February of the present year. The disease had apparently been introduced in the first instance by a boy named James N——, aged nine years, who had been admitted on November 17th, 1894, for subcutaneous abscesses of the abdomen. He had been treated outside the institution for pneumonia, and was found to have been ill for about three weeks previous to admission. It was thought at the time of his reception into the Infirmary that the disease from which he had suffered in the first instance had not unlikely been enteric fever, and this was rendered the more probable from the fact that on November 28th he had a relapse accompanied by a sustained rise of temperature which lasted until December 9th, during which time about 20 fairly typical rose-spots appeared on the abdomen. During this period also, the lad suffered from diarrhœa. He was treated in the general boys' ward during the whole of his illness, and the excreta, which after the first fortnight of his illness were disinfected with carbolic acid, were emptied into the pan of a closet the soil-pipe from which was, later on, found to be defective. In this connexion, I may mention that the Infirmary buildings, which are far from modern, were originally erected as a private dwelling, and are therefore by no means well adapted for the purposes of a hospital.

About a couple of days after this boy's temperature had fallen to normal, Nurse P————, æt. 24, who was on night duty in the ward in which he had been treated, complained of pains in the knees, shivering, headache, and general malaise. On January 1st her illness was definitely diagnosed as enteric fever. She had, I learnt, joined the staff in November 1894, and had had no holiday since then. She had also acted for a few days as day nurse in the boys' ward previously to taking on night duty. Her temperature had fallen to normal by January 15th.

It appears fairly certain that Nurse P———, must have, in some way, contracted enteric fever from James N——— whom she had been nursing,

and it was, indirectly, no doubt, to this same case that infection was due in three subsequent cases which broke out in the Infirmary. These cases included two other members of the nursing staff, viz., Nurse S——, æt. 23, whose illness, as indicated by elevation of the temperature, lasted from February 6th to February 28th, 1895, and who had been on duty in the boys' ward since December 15th of the previous year; and Nurse C——, æt. 20, who also had worked in the boys' ward from the date of entering the service of the Infirmary at the beginning of February 1895, and whose illness (a somewhat abortive attack of enteric fever) lasted from February 18th to March 2nd; and finally, though almost synchronously as regards the period of invasion, Pamela B——, who, as already stated, left the Infirmary for her home at Loddon on February 6th, 1895.

With reference to this minor outbreak at the Jenny Lind Infirmary, it is of interest to note that an examination of the drainage system revealed the fact that the soil-pipe leading from the closets into the pan of which the bowel discharges of the boy James N——, and later on of the affected nurses, were thrown, had become blocked during the severe frost which persisted during the first three months of the present year, and had become cracked at a point where it passes under the flooring of the hall between the boys' and girls' wards, so that when the smoke test was applied the smoke came up between the floor boards in such volumes, so the matron informed me, as to fill the whole house. This being so, the whole drainage system was at once overhauled and put into thorough repair, and since then no further case of the disease has broken out in the Infirmary.

The true nature of the malady from which Pamela B—— was suffering was first recognised, as already stated, on February 18th, 1895, about a fortnight after her return to Loddon, and the case was immediately notified as one of enteric fever. The Medical Officer of Health, Mr. Prior, at once directed that the patient should be isolated at home as far as this was possible, that disinfectants should be freely employed about the sick room, and should be placed in the bed-pan used to receive discharges. He also ordered the privy into which they had previously been emptied to be cleaned out and to be well sprinkled with lime. The slop drain in the back yard of the house was also well flushed out with water and afterwards with a solution of carbolic acid.

An interval of about five weeks elapsed before a second case, that of Hilda B——, æt. six years, was notified on March 22nd. This child, a sister of the first patient, doubtless contracted the disease through personal infection from Pamela B——, as, doubtless, also did their mother, Mrs. B——, who had been nursing her eldest daughter since her return home, and whose case was notified as one of enteric fever on April 1st, 1895.

All the members of this family lived in a small cottage on the north side of the Green.

No further cases occurred in Loddon for nearly three weeks, but on April 17th no less than six notifications of enteric fever were received

by the Medical Officer of Health. Of these six persons attacked four were living in Loddon itself, while the other two were children who lived in the adjoining villages of Heckingham and Hales respectively, but who attended the Board School at Loddon.

The progress of the disease in Loddon and the neighbourhood, from this point onwards, is shown as regards the dates of notification of cases in the following table :—

Date.	No. of Cases Notified.
April 17th, 1895	6
„ 19th, „	4
„ 20th, „	4
„ 21st, „	1
„ 22nd, „	1
„ 25th, „	3
„ 28th, „	2
May 3rd, „	1
„ 8th, „	1
„ 10th, „	1
„ 13th, „	2
„ 15th, „	2
„ 24th, „	1

Since May 24th no further cases of the disease have appeared in Loddon.

On looking through the list of notifications of the disease, supplied to me by Mr. Prior, the Medical Officer of Health, I was struck by the fact that of the attacks which occurred in persons living outside the town, four in number, coming from three different villages, all were boys aged respectively from 10 to 11 years, each of whom had been attending the Loddon School, and that in none of these cases had infection spread to other members of their families.

Of these four patients, Nos. 6, 8, 15, and 17, in the list of cases* appended to this report, two were notified on April 17th, and two on April 25th, 1895. Of these four boys two eventually recovered and two died.

I at once made inquiries at the Loddon School as to the number of boys and girls respectively who, though living in outlying villages, attended this particular school. From the master's books I found that the average number of scholars coming under this category were 20 boys and 25 girls. I found further that of these children, all, in consequence of the distance of their homes, remained in Loddon for their mid-day dinner, most of them bringing it with them and consuming it on the school premises. This was so, I learnt, in the case of all the girls, 25 in number. With regard to five of the 20 boys, however, arrangements had been made, as I was informed, for them to have their dinner with friends or relatives in Loddon, the remaining 15, like the

* Not reproduced.

girls, partaking of provisions which they brought with them, either in their school-room, or, in fine weather, on the town green outside the school. As all the four cases of enteric fever which occurred outside Loddon itself had been among the boys who not only attended the Loddon School but regularly dined there, while, at the same time, among the larger number of "out-town" girls, some of whom came from the same villages, and who also dined there, no cases were reported, it became of interest to determine, if possible, whether there existed any difference in their circumstances while at school in the town where, at the time, the disease was asserting itself, sufficient to account for its incidence on the boys only.

Further inquiry elicited the fact that the girls always dined in their own school-room, under the supervision of one of the pupil-teachers, and that they obtained what water they required for drinking purposes from a pump-well in the playground behind their school-room. There is, however, no play-ground attached to the boys' school, the town green serving this purpose, and consequently they are accustomed to obtain their drinking-water from the town pump, which is situated in the centre of the Green.

I found at the time of my visit that, locally, suspicion had arisen as to the water of the town pump having some concern in the spread of enteric fever in the place, and it will, I think, be admitted that the curious incidence of the disease on certain of the boys only of the "out-town" children attending the school, a fact which prior to my visit had not apparently been appreciated, lends some support to this view.

On eliciting the information detailed above, it became of interest to inquire whether such a theory of water-carriage of the infection was capable of accounting for the spread of the disease among persons living in the town itself, who were attacked subsequent to the appearance of the disease in the family first invaded.

Bearing in mind, however, at the same time other possible sources of infection, I obtained information as to both water and milk-supply of all those persons who from first to last had been attacked by the disease, and the results of such inquiry are embodied in the tabular statement of cases* given in the addendum to this report. Personal infection, I found, was certainly not capable of accounting to any considerable extent for the spread of the disease, seeing that many of the patients, though being in the same small town, were practically strangers one to another, and had not visited other of the invaded households. The washing of dirty linen was also, as I was informed, done for the most part, though not entirely, in the patients' own houses. With reference to milk-supply, I learnt that not only was the total amount of milk consumed in each of the invaded households for the most part extremely small, but also that it was obtained from a variety of sources. On the other hand, although there are probably between sixty and seventy surface wells in different parts of Loddon, in by far the greater number of invaded households it was from the town pump that the water-supply had been obtained.

From what has already been set down, it will be obvious also that where on the table some source of supply other than the town pump is indicated the patient had, on occasion, at any rate, been accustomed to drink water from this particular well. One possible exception to this statement will, however, require notice later on in this report.

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* Not reproduced.

There being some reason, therefore, for suspecting that infection had been spread through the medium of drinking-water obtained from the town pump, I sought for any further evidence which might tend to support this view, and which, if the suspicion were well grounded, might afford an explanation as to the manner in which the well with which this particular pump is connected had in the first instance become infected.

With reference to the first point, it is of interest to note that, with very few exceptions, the houses in Loddon invaded by the disease are in close proximity to the Green, in the centre of which the town pump stands.

The fact also that after the occurrence of the first three cases, all in the same family, the disease broke out almost simultaneously in a number of different households, among whom, as far as I could learn, no circumstance existed in common other than the use of drinking-water obtained from this particular source, undoubtedly tends to support the suspicion that the water of the town pump must have had some causal relationship with the spread of the disease. On endeavouring, however, to elucidate the manner in which the water-supply in question had itself become the recipient of infection by the specific organism of the disease, supposing such, indeed, to have been the case, no very satisfactory evidence appeared to be forthcoming. At first sight there appeared a likelihood of such infection having been brought about through the cleansing and emptying over the site of the well of utensils of one and another kind, which had been in use in the family first invaded, and I was informed by certain of the residents that such cleansing and emptying had in fact taken place.

On making inquiry, however, of Mrs. B—— with reference to this point, she strenuously denied that the statement made to me had any foundation in fact. She admitted that water for drinking purposes had indeed been regularly obtained from the town pump, and that her husband and one of her sons had been accustomed to fetch it each day in a galvanised iron pail which was kept for this particular purpose and for none other. Thus, although it would have doubtless happened that this pail would be rinsed out prior to being filled with the day's supply of water, yet it was certain, she said, that no slops or other household refuse had been emptied over the surface of the well. Be this as it may, however, it is not beyond the range of possibility that a pail kept on the premises, even though supposed to be kept for drinking-water only, may have had its contents at some time or other infected by the specific poison of the disease, even though the inmates of the dwelling may have been unaware of the fact.

Curiously enough, on April 23rd, some seven days after the date on which the disease first became at all generalised in Loddon, the water-supply afforded by this particular pump gave out in large measure. This was probably due in part to the fact that one of the buckets used for drawing the water had become damaged, and also in part to the supply having become actually lessened in consequence of continued drought. On May 4th the use of this well was entirely prevented, the handle of the pump having been chained up by order of the Rural District Council for the reason that chemical analysis had shown that the water obtained from it was altogether unfit for drinking purposes. Comparing these dates with those on which the later cases of the disease were notified, it is of interest to observe that, with a single exception, the disease had completely died out within three weeks of the supply coming practically to an end, and within less than a fortnight of the pump being chained up. Calculated from the date of notification

of the very last case (a period of nine days from the date of the immediately preceding ones), these periods become, as nearly as possible, a month and three weeks respectively. According to the Report of the Committee of the Clinical Society, even the longest of these intervals of time might be included within the possible incubation period of enteric fever. So that, from this consideration also, it would appear not improbable that the disuse of the water-supply afforded by the town pump and the cessation of the disease may have stood in the relation to each other of cause and effect.

Up to the time of writing (July 1895) no further case of enteric fever has been reported from Loddon or the neighbourhood.

From first to last 32 cases of the disease were notified, of which, with the exception of the first three, all occurred within a period of about five weeks. Of these 32 cases no less than 8 died, giving a death-rate of exactly 25 per cent.

Earlier in this report I have referred to the fact that with few exceptions all those persons who, during the recent epidemic became attacked by the disease, had been obtaining their supply of drinking-water from the town pump. On the other hand, a few cases of the disease occurred among those who locally were believed not to have consumed this water. Of these cases four occurred in the villages of Heckingham, Hales, and Raveningham respectively. All the four cases which occurred at these villages were boys attending the Loddon School. To these I have already referred as among the "out-town" children, who were accustomed to bring their dinner to school, and, in the case of the boys, as I found, had obtained their drinking-water from the town pump. A further case which, however, I found it quite impossible to account for on the theory of possible infection of the town pump was that of William W————, aged 34, who lived on the extreme outskirts of the town, some distance beyond the church. The cottage inhabited by this man is, except for two others in the immediate neighbourhood, and in which no cases of the disease occurred, quite isolated, and has a pump well of its own from which drinking-water is obtained. This man's wife informed me that, to the best of her belief, he had never drunk any water from the town pump, and she added that, as he was not on the best of terms with his relatives, he very rarely paid a visit to any of the houses in the town. I found, however, that previous to his illness he had been working on one of the allotments, which he rented, and which was close to another one, which, in turn, was rented by the family of B——, in which household the disease had first appeared. As I have already stated, as soon as the true nature of the disease was ascertained, all the discharges from the infected persons of this family were taken daily up to the allotments, and there, as I was informed, buried in the ground, the receptacles being afterwards cleansed in the small brook which runs under the lane leading from the churchyard to the allotment ground. It appears conceivable, therefore, that this man W—— may have become infected through the medium of the air while working on these allotments. In spite of all endeavours, I found it quite impossible in his case to trace any other means of infection, such as through personal communication or through the medium of infected milk or water.

At the time that suspicion first attached to the water-supply of the town pump, a chemical analysis of the water was ordered to be made with the result shown in the addendum to this report.* It is there stated that this water is unfit for drinking. An analysis made of the water

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* Not reproduced.

taken on the same day (May 1st, 1895) from the pump in Campbell's yard showed that this also was a very impure water. "The albuminoid ammonia, nitrates, and oxygen absorbed are much in excess; the "supply is heavily polluted with sewage and is unfit for drinking." In consequence of the result of these analyses both wells were ordered to be closed immediately. In the case of the town pump, however, in order to see whether any improvement could be brought about in the quality of the water, the well was opened out, cleansed, "bottom-fied," and the water pumped out repeatedly, after which a supply of lime was put into the well. While these operations were in progress a large "soakage" well was discovered at a distance of about 5 yards from the pump well, and connected by a pipe-drain with the covered gulley into which waste water from the pump was received. This soakage well was apparently between 8 and 9 feet deep, but on investigation it was found that there existed a further depth of about 15 feet, which was filled up by black mud, the bottom of which was, roughly speaking, on a level with the surface water in the pump well. No direct overflow from the soakage well had been provided, so that as neither well was steined it is very probable that a quantity of fluid material found its way through the intevening soil from the soakage well to that in connexion with the town pump. In consequence of this supposition the mud was removed from the soakage well, some lime was placed at the bottom, and the whole filled in with soil. At the same time the drain from the wastewater gulley was diverted at right angles to its former course so as to discharge into the main drain in the roadway close at hand. Afterwards water was again pumped more or less continuously from the well for some time, after which the second specimen was taken for chemical analysis. The result of such analysis, however, showed that the water was as unfit as ever for drinking purposes, and therefore the pump has remained chained up since in order to prevent its further use for drinking purposes. At the time of my visit a further specimen of water was taken from the town pump and sent to Dr. Klein for the purposes of a bacteriological examination. He was unable to find evidence of its infection by the specific organism of enteric fever, but the result of his examination showed that the water must have been subject to pollution by excretal matters.

Sanitary Administration.—The Medical Officer of Health receives a salary of 80*l.* per annum, the half of which is repaid out of county funds. Mr. Prior appears to have a fair knowledge of the duties of his post, but his district is so extensive that it is impossible for him to give adequate attention to the needs of every portion of it. At present, there is no Inspector of Nuisances, the official who held that post until recently having resigned, while I am informed that up to the present time (July 1895) no one has been appointed to succeed him. The salary is 40*l.* per annum, or at the rate of 1*l.* per parish. Of this amount, as in the case of the Medical Officer of Health, a moiety has been paid from county funds.

The District Council possess no isolation hospital for infectious cases, neither have they any apparatus for disinfection of clothing or bedding, and the Medical Officer of Health informs me that the question of providing hospital accommodation or disinfecting apparatus has, as far as he is aware, never been brought before the Authority.

The Infectious Disease (Notification) Act is in force in the district, but no part of the Infectious Disease (Prevention) Act. The Authority, I was informed, make no provision whatever for the removal of excrement or household refuse, this having to be done, therefore, by or at the expense of the individual householders themselves.

Before leaving Loddon, the Clerk, at my request, called a meeting of the local representatives of the Rural District Council, which I attended. The Medical Officer of Health was also present on this occasion. After referring to the reason of my visit and to the results, up to that time, of my investigations, I made certain recommendations which I thought it desirable should be brought to the notice of the Council. These had reference to (1) the provision, if it were found possible, of an improved water supply for the whole of the town; (2) the provision of hospital accommodation for cases of infectious disease and of an efficient disinfecting apparatus; (3) the filling in of most of the dykes at present existing in the lower levels of the town and the improvement of the present cesspools and privy middens so as to prevent the contamination by them of the subsoil; (4) the desirability of not re-opening the town pump for public use or, if this could not be insisted on in consequence of the supplies obtained elsewhere being deficient in quantity, the necessity of the water being boiled previous to use for drinking purposes.

No. 9.

REPORT on an OUTBREAK of DIPHTHERIA at LLANFYNYDD, in the LLANDILOFAWR RURAL DISTRICT of CARMARTHENSHIRE; by Dr. R. DEANE SWEETING.

APP. A. No. 9. On Diphtheria at Llanfynydd; by Dr. Deane Sweeting.

According to the Registrar-General's return for the quarter ended December 31st, 1894, 12 deaths from diphtheria occurred in the Llanfynydd sub-district of the Llandilofawr Registration District, all of which were reported as having taken place in the parish of Llanfynydd. Inquiry was therefore ordered by the Board, and I visited the district early in March for that purpose.

Llanfynydd is one of 12 parishes constituting the Llandilofawr Registration District, which is conterminous with the union of that name. The Llandilofawr Urban District comprises what has heretofore been a part of one of these parishes, viz., Llandilofawr. The rest of the Registration District forms the Llandilofawr Rural District.

Table A. shows the area, number of inhabitated houses, and population at the 1891 census of the 12 parishes contained within the Llandilofawr Rural District.

TABLE A.—Showing the AREA, NUMBER of INHABITED HOUSES, and POPULATION at the Census of 1891 in each of the 12 Parishes constituting the Llandilofawr Rural District.

Name of Parish.	Area in Acres.	Number of Inhabited Houses. (1891 Census.)	Population. (1891 Census.)
Llansawel - - -	10,250	179	898
Talley - - -	7,198	167	754
Brechfa - - -	534	26	85
Llanfynydd - - -	*10,850*	*217*	*949*
Llanfihangel - - -	6,674	191	927
Llanegwad - - -	12,454	345	1,508
Llangathen - - -	5,609	174	750
Llandyfeisant - - -	970	31	125
Llandilofawr (part of)* -	26,695½	920	4,351
Quarter Bach - -	7,704	326	1,617
Llandebie - - -	10,804½	887	4,388
Bettws - - -	6,511	473	2,417

* The remainder of the parish comprises the Llandilofawr Urban District.

The parish of Llanfynydd (area, 10,850 acres; inhabited houses, 217; population, 949) contains the village of that name and numerous outlying farms and hamlets. The village, situated about 10 miles north-west of the town of Llandilo, is picturesquely placed on the slopes of a valley watered by the Sannan, a tributary of the River Towey. There are altogether in the village 48 houses, and a population of 142, mostly engaged in agricultural pursuits and petty trading. The outlying farms and homesteads, which contain the bulk of the inhabitants of the parish, viz., 807 persons in 169 houses, are scattered over a large area, and are situated for the most part on elevated ground. A large area of the parish, including the village, is on the Lower Llandovery Rock, of the Lower Silurian series, which in many places comprises beds of conglomerate sandstone and schist; part only of the parish is on

the Caradoc or Bala formation of the same series. A stiff loam, of variable depth in different parts of the parish, overlies these strata.

Sanitary Circumstances.

Condition of Dwellings.—The majority of houses in the parish are of stone, whitewashed outside. Some are of brick. The roofs of some are slated, of others thatched. The floors of a few better class houses are boarded, but those of the bulk of the cottages consist merely of earth irregularly covered with a kind of concrete, or of large, badly-laid flat stones. I found many leaking roofs, cracked walls, and damp floors, particularly in the parts of the parish outside the village. Some of the houses in the village are built up close against the side of the hill, and, receiving therefrom much percolation, have their walls and foundations damp, whilst a few others have pigstyes built up close to and adjoining them. Dampness of habitations and of the ground about them is especially frequent in the outlying portion of the parish.

Water Supply.—This is obtained in the village from open dipping wells and roadside spouts fed by "springs." The former are exposed to contamination from surface washings and organic liquid refuse, as well as from the dipping in of dirty vessels; whilst the roadside spouts are often so circumstanced as to raise a doubt as to whether they do not as a matter of fact convey merely land drainage. At the outlying farmsteads, water, besides being often difficult of access, is supplied from roadside spouts similar to those above described; from open shallow dipping wells, greatly exposed to pollution; and from overflow from springs which is conducted along open surface carriers (ofttimes for some distance) before being piped.

There are one deep and two shallow wells in the village, both sunk into the rock.

Excrement Disposal.—There is no privy accommodation at all for the outlying places, nor at several groups of cottages in the village of Llanfynydd. What privies there are in the village, though as a rule well removed from the cottages, are of most imperfect construction and arrangement, their receptacles being commonly mere rude holes in the ground. Their contents are said to be shovelled out and applied to garden ground; but in many cases they are flushed out by road surface water, which is directed through the privies, or even by hand-thrown water. Some of the excremental matter thus irregularly flushed out reaches the Sannan Stream; but much of it does not get so far, and pollutes the ground in the vicinity of the cottages. Some privies consist merely of a seat over a running stream feeding the Sannan; whilst in one case the privy is placed over a farm pond, the overflow from which reaches the same stream. A few of the better houses are provided with pail closets; the contents of these are ordinarily applied to the land, but in some cases are thrown into the Sannan.

Refuse Disposal.—There are no receptacles for the disposal of refuse. In the outlying portion of the parish refuse is thrown on to the ground near the house; in the village this obtains to some extent too, but most of the refuse is placed on the banks of the Sannan, or thrown into the stream itself. On the banks of this rivulet are to be seen heaps of ashes and of animal and vegetable refuse, particularly near the bridge in the centre of the village. All these substances are apt to be swept into it during flood time. The Sannan, which thus receives, directly or indirectly, much excremental and refuse material from the village of

Llanfynydd, has a rapid flow in winter, but is sometimes almost stagnant in summer and during dry weather, at which times noisome odours are said to be given off from it.

There is entire absence of drainage in the whole parish, and household slop water is thrown on to the ground haphazard, to find its way into the foundations of houses, or into any ditch or stream that may be near.

Prevalence of Diphtheria in the Rural District.

In the period 1881–94, diphtheria has, probably, not been absent in any year from the Llandilofawr Rural District. Table B. shows the number of deaths from this disease and from affections of the throat, such as membranous croup, laryngitis, &c., which must be considered to have been closely allied to diphtheria in nature, during the 15 years, 1880–94.

Table A.—Giving the Number of Deaths from (*a*) Diphtheria (*b*) certain Throat Affections, such as Membranous Croup and Laryngitis, in the Llandilofawr Rural District (Acreage, 106,254; Population, 18,769) during the 15 Years, 1880–94.

Year.	Deaths from Diphtheria.	Deaths from Throat Affections not designated Diphtheria.
1880	—	—
1881	—	4
1882	—	2
1883	1	5
1884	—	4
1885	—	1
1886	—	4
1887	3	2
1888	2	5
1889	3	3
1890	2	4
1891	1	5
1892	3	4
1893	1	2
1894	13	8
1880–94	29	53
Yearly average	1·9	3·5

From this it is seen that from 1881–86 fatal throat illness was not generally designated diphtheria; and that not until 1894 did deaths registered as due to diphtheria greatly outnumber deaths referred to throat illness. It will be noticed that the diphtheria mortality in the Rural District during 1894 was six times, and that from allied throat diseases more than double, the yearly average.

Seeking now to ascertain in what parishes of the Rural District diphtheria and throat illness similar in kind had recently prevailed, I have drawn up a table showing this for the five years, 1890–94.

App. A. No. 9.

On Diphtheria at Llanfynydd; by Dr. Deane Sweeting.

TABLE C.—Showing the PARISHES of the LLANDILOFAWR RURAL DISTRICT affected with MORTALITY from (*a*) DIPHTHERIA, (*b*) certain THROAT AFFECTIONS, such as MEMBRANOUS CROUP and LARYNGITIS, during the Five Years, 1890–94.

Parish.	Population.	1890. Deaths from		1891. Deaths from		1892. Deaths from		1893. Deaths from		1894. Deaths from		1890–94. Deaths from		Average Annual Incidence per 1,000 of Population.
		Diphtheria.	Throat Affections.	Diphtheria.	Throat Affections.	Diphtheria.	Throat Affections.	Diphtheria.	Throat Affections.	Diphtheria.	Throat Affections.	Diphtheria.	Throat Affections.	
Llangathen	750	1	1	—	—	—	1	—	—	—	—	1	2	0·80
Llansawel	898	—	2	—	—	—	—	—	—	—	—	—	2	0·44
Bettws	2,417	—	1	—	—	1	1	—	—	—	3	1	5	0·49
Llandilofawr*	4,351	1	—	1	—	1	1	1	1	1	3	5	5	0·4[illegible]
Llanegwad	1,508	—	—	—	2	—	—	—	—	—	—	—	2	0·26
Llandebie	4,388	—	—	—	3	—	1	—	1	—	1	—	6	0·27
Brechfa	85	—	—	—	—	1	—	—	—	—	—	1	—	2·35
Llanfynydd	949	—	—	—	—	—	—	—	—	12	1	12	1	2·73
Eight parishes of the Rural District.	15,346	2	4	1	5	3	4	1	2	13	8	20	23	0·56

* Rural part.

It will be noticed that altogether eight parishes of the Rural District contributed to the mortality from throat affections during the period specified. Of these only one, viz., Llandilofawr parish (rural part) has been affected during every year of the five. But Llanfynydd parish, containing a population less than a fourth of that of Llandilofawr parish, though affected during only one year of the period, viz., 1894, furnished during that year a larger mortality from this cause than Llandilofawr parish (rural part) during the whole five years—13 compared with 10—and nearly one third of the grand total of this mortality in the eight parishes for that period.

DIPHTHERIA AT LLANFYNYDD.

This marked incidence of mortality from throat illness on the parish of Llanfynydd during the year 1894, comprising nearly two thirds of the total diphtheria mortality from this cause in the Rural District during that year (viz., 13 deaths out of 21), when reckoned as an average of the five years, 1890–94, equals about five times the annual incidence per 1,000 persons living on the whole Rural District (2·73 compared with ·56). *See* Table C.

In addition to a death, on January 8th, 1894, at a farmhouse in the parish, of a girl, aged four years, registered as "acute laryngitis," which may probably have been diphtheritic in nature, there were between November 30th and the end of the year 12 deaths from diphtheritic throat malady in the parish, and from then to March 19th, 1895, 5 more. Altogether during the period, November 1894 to March 1895, I got to hear of some 52 cases of diphtheria and sore throat, though, owing to absence of notification, compulsory or voluntary, these were probably

not all that occurred. They are set out according to specified age-periods in Table D., which gives also the case-mortality at each period.

App. A. No. 9.

On Diphtheria at Llanfynydd; by Dr. Deane Sweeting.

TABLE D.—Showing for each of certain AGE-PERIODS the NUMBERS ATTACKED with DIPHTHERIA and THROAT ILLNESS in the PARISH of LLANFYNYDD during the OUTBREAK (1894–95), and the NUMBER of DEATHS, with the CASE-MORTALITY.

Age-period.	Numbers attacked.	Number of Deaths.	Case-mortality.
0— 3 years - - - -	3	1	33·3 per cent.
3—13 " - - - -	38	14	36·8 "
13—20 " - - - -	7	2	28·5 "
Over 20 " - - - -	4	—	—
All ages - - - -	52	17	32·7

The bulk of the cases (38 out of 52) were thus of school age (3 to 13 years), and fatality was greatest at this age. About one third of the total known cases died.

The next Table (E) shows the attacks and deaths in the parish during the successive weeks November 6th, 1894, to March 18th, 1895.

TABLE E.—Showing the DISTRIBUTION WEEK by WEEK of ATTACKS and DEATHS from DIPHTHERIA and THROAT ILLNESS in the PARISH of LLANFYNYDD during the period November 6th, 1894, to March 18th, 1895.

Week ending	Number of Attacks.	Number of Deaths.
November 12th, 1894 - -	2	—
" 19th - - -	—	—
" 26th - - -	3	—
December 3rd - - -	9	1
" 10th - - -	12	3
" 17th - - -	4	4
" 24th - - -	5	3
" 31st - - -	5	1
January 7th, 1895 - -	1	—
" 14th - - -	2	—
" 21st - - -	1	—
" 28th - - -	—	1
February 4th - - -	1	1
" 11th - - -	1	—
" 18th - - -	1	—
" 25th - - -	—	—
March 4th - - - -	—	—
" 11th - - - -	3	1*
" 18th - - -	2	2*
November 6th to March 18th -	52	17

* Died subsequently.

It will be seen that there was a considerable increase in the number of cases during the first two weeks of December, and in the number of

App. A. No. 9.
On Diphtheria at Llanfynydd; by Dr. Deane Sweeting.

deaths in the second, third, and fourth weeks of that month. The disease showed signs of subsidence early in January, which was maintained during February; but there was recrudescence, especially of fatal attack, in March. At the date of this report (March 29th) there are still a few cases in the parish, all confined to the village.

Of the total 52 cases, 33 occurred in 15 houses in the village; the remaining 19 were in 10 outlying houses. Fifteen of the 17 deaths were in the village. This gives a house-incidence of 31·2 per cent. in the village and ·5 per cent. in the outlying part; an attack rate per population of 22·3 per cent. in the village and 2·3 per cent in the outlying parts; mortality-rates of 10·5 and 0·24 per cent. in the village and rest of the parish respectively; and a case-mortality of 45·4 and 10·5 per cent. These figures embodied in Table F., afford a strong contrast between the behaviour of the disease in these two different parts of the parish.

TABLE F.—Showing for the VILLAGE and for the REST of the PARISH of LLANFYNYDD, the NUMBER in each instance of HOUSES and of POPULATION, the NUMBER OF HOUSES INVADED and PERSONS ATTACKED, and the DEATHS during the OUTBREAK of DIPHTHERIA (November 1894 to March 1895). The PER-CENTAGE of HOUSE-INCIDENCE, the ATTACK and MORTALITY RATES, and the CASE-MORTALITY are added.

Part of the Parish.	No. of Houses.	Population.	Houses Invaded.	Persons attacked.	No. of Deaths.	House Incidence per 100 Houses.	Attack-rate per 100 Inhabitants.	Mortality-rate per 100 Inhabitants.	Case-mortality per 100 Cases.
The Village	48	142	15	33	15	31·2	23·2	10·5	45·4 p.c.
The outlying portion.	169	807	10	19	2	0·5	2·3	0·24	10·5 p.c.
						(62 : 1)	(10 : 1)	(42 : 1)	(4 : 1)
Parish of Llanfynydd.	217	949	25	52	17	11·5	5·4	1·7	32·6 p.c.

The earliest cases of the outbreak heard of during my inquiry were a girl of 13 years and a boy of 9 years, sister and brother, living at a farm in the village, and both attending the National School there. They had what was thought to be merely "bad colds," but both suffered from hoarseness and debility. Their illness came on in both cases about November 12th. I have since learned, however, from the schoolmaster, who was away from Llanfynydd at my visits, that he noticed several other children with similar symptoms as far back as the end of October.* The farmhouse where these two cases occurred in November 1894 has damp walls, is surrounded by reeking, offensive, liquid refuse, is entirely without drainage, and is provided with a privy emptying directly over a pond. There had been no illness amongst the milch cows there: a heifer had died, but as far back as June 1894, from "blain," a disease characterised by bloody blisters under the tongue and at the back part of the mouth. Another child here, aged four years, was attacked with sore throat on December 4th, and the father, aged 40, on December 7th.

* Some of these cases, however, are said by medical men to have been merely cases of "Simple Catarrh."

On November 25th another girl (of 13 years) in the village was attacked with throat symptoms, and within the next five days four other members of her family, all attending the National School, were also attacked; of these five cases, three died. The true nature of the complaint was now recognised, and the school was closed on November 30th.

Inasmuch as the school and certain arrangements thereat have been freely blamed for causing the outbreak of diphtheria at Llanfynydd, it now becomes necessary to examine this point in some detail.

Including the early cases of sore throat of which I was informed by the schoolmaster, it may be said that there were about a dozen cases of throat affection amongst the scholars during the month preceding closure of the school on November 30th, compared with about 30 during the month following school closure. Thus :—

School Open.	School Closed.
End of October to end of November.	End of November to end of December.
12 Cases.	30 Cases.

As it stands, this would in itself not afford any strong indication of unfavourable school influence. Moreover, there were a few instances of the escape of scholars when other children in the family were attacked, and of first cases in families not being school attendants. But these were found to be children at the outlying farms, attacked mainly some few weeks after the closure of the school. In the two village families definitely attacked with diphtheritic malady before the school was closed, and, generally, in the whole parish for a short time after that event, non-schoolgoers escaped, irrespective of age; first attacks in families were in children who attended school, and, in a few cases, all the school attendants in families suffered from the disease.

In any case, the increase in attacks, from three in the week ending November 26th to nine in that ending December 3rd, with the corresponding rise in mortality during this and succeeding weeks, is consistent with the fact of school assemblage having served to foster and give impetus to the throat disease, which had begun to prevail in Llanfynydd during the month prior to the date at which the school was closed.

The Llanfynydd National School consists of one room, measuring 40 ft. × 21 ft. 6 ins. × 16 ft., situated over a three-roomed house in the village, but having a separate approach from the road. The number of children on the books is 86, and the average attendance during 1894 was 56. The above dimensions give on the average 15 square feet of floor space, and 246 cubic feet of air space, per head. The school contains seven windows, four on one side and three on the other, but in each of these windows only a small casement, measuring 15 inches by 15, is made to open; and there is a space of about 3 feet between the top of each window and the spring of the roof, which is quite without ventilation. It appeared to me, therefore, that the ventilation arrangements at the school were hardly adequate to effect a thorough change of the air of the room in the interval between school hours. Much local complaint as to the offensiveness of the school privies, placed some 10 yards away from the school, was made to me during the inquiry. At

my visit they had been pulled down, and their contents buried with chloride of lime. New closets are to be erected, in accordance with plans of the Education Department, and it is proposed to adopt the use of movable receptacles, as pails or tubs. Some, at least, of the alleged offensiveness from these closets may have been confounded with that from a neighbouring pigstye close to them. In any case, there appears no reason for directly connecting the sudden and fatal diphtheria at Llanfynydd in 1894 with school-closet conditions which had been obtaining there for many years previously So, too, as regards the alleged dirty condition of, and absence of drainage for the dwelling underneath the school, which were looked upon by some as a contributing cause of the epidemic, by allowing of noxious emanations into the schoolroom.

As regards the influence of sanitary surroundings in determining the appearance and spread of diphtheria, though dampness of houses and their surroundings, absence of or faulty privy accommodation, as well as water supplies of suspicious source, were found at many of the invaded houses, such insanitary circumstances were by no means confined to these houses, but obtained as well at houses which did not suffer invasion.* At the same time, the various unwholesome conditions before alluded to as existing at Llanfynydd, *e.g.*, of dwellings, of water supply, of excrement and refuse disposal, as well as the absence of drainage, and the state of the Sannan, doubtless made up a sum total, tending to pollution of air and soil, and inviting disease. As for milk, each household in the outlying part is supplied by its own cows. This obtains largely, but not exclusively, in the village, where there are a few local dealers. There was no evidence at all tending to implicate milk as a vehicle of infection throughout the parish.

I could learn of no connexion whatever betwixt the autumn outbreak of diphtheria at Llanfynydd and any cases earlier in the year at the other parishes affected (mentioned in Table C.) viz.:—Bettws, Llandilofawr (rural part) and Llandebie, nor with any prevalence of the disease in the urban district of Llandilofawr. There had been only two cases of diphtheria recognised in the latter district in 1894, both in December, after the outbreak in Llanfynydd had begun.

The malady has been undoubtedly propagated in Llanfynydd by means of personal communication, as at school, or in visiting at infected houses, whilst, owing to the absence of a hospital, no serious attempt at isolation could be made. The value of isolation is shown by the instances of two households, the remaining children in which escaped attack by being sent away from Llanfynydd when the first cases in their houses broke out, whilst in several other households in which no such precaution was adopted, secondary cases occurred among other members of the family.

The excessive incidence on houses and persons in the village, as compared with that on the outlying portion of the parish, and the higher fatality there (*see* Table F.) are largely explainable by the greater opportunities for such personal intercommunication at the village. But perhaps difference in elevation and density, too, may have been correlated with this. For in the outlying part, houses are sparse and scattered on high ground, whereas in the village they are more closely aggregated in a distinct hollow.

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* In one house, however, in which five children out of seven children were attacked and three died, there was evidence of some overcrowding.

The illness of an adult was ascribed to his using the same spoon as one of his children who was ill. A farmer living outside the village had attended several funerals of diphtheria cases there shortly before the disease broke out in his family.

As to illness of the lower animals, except the heifer afflicted with "blain" in June 1894, already referred to, I learned of none, except a malady among domestic fowls in the summer of 1894, at an isolated farmhouse where diphtheria prevailed subsequently amongst the inmates. These fowls are said to have shown aversion to food, and difficulty in swallowing, rapidly followed by death.

A general statement was made to me of prevalence of "ulcerated teats" amongst cows at certain farms in the parish during the autumn of 1894; but I could obtain no definite corroboration of it, and there had been no diphtheria recognised on any of these farms. And, as stated before, there was no evidence upon which to base any suspicion of milk having been concerned in the outbreak.

Measures taken by the Authority.

The school had been voluntarily closed by the Managers before formal notice to do so was sent to them by the Rural Authority. The building was then cleaned and fumigated. The limewhiting ordered by the Medical Officer of Health had not yet been carried out at the date of my visit. The school closets were pulled down, and the contents buried in the earth with chloride of lime. The pigstye close to the school was ordered to be disused, and was cleaned out and limewhited. At my suggestion, the Medical Officer of Health has requested the Vicar of the Parish, as representing the Managers, to provide additional ventilation at the school.

Except these proceedings, and some fumingation of infected houses by means of sulphur candles, nothing was done to check the outbreak, which is not (at the date of this report) yet exhausted at Llanfynydd. The outbreak was not even reported to the Local Government Board by the Medical Officer of Health, as required by his instructions. After my visit, Mr. Lloyd, the Medical Officer of Health, proposed to the Rural District Council that they should rent a small cottage for the reception of sufferers from diphtheria; but this was not agreed to. There is no compulsory notification of infectious diseases in the district, the 1889 Act not having been yet adopted. The Authority and their officials appear to have been apathetic as to the sanitary requirements of Llanfynydd. Scarcely anything has been done to remedy the patent and notorious sanitary defects in the parish. I find that during the past 10 years only 12 notices to abate nuisances in Llanfynydd parish have been served. Of these there were in 1885, five; 1886, one; 1889, one; 1891, one; 1892, one; 1893, two; 1894, one. Of these, four notices referred to the school closets. No visits are recorded in the journal of the Inspector of Nuisances as having been paid to the parish between 1886 and 1889.

Before leaving the district, I conferred with the Clerk, the Medical Officer of Health, and the Inspector of Nuisances. I endeavoured to impress upon the Clerk, as representing the Authority, the importance of adopting the Infectious Disease (Notification) Act of 1889, and of providing some, if only temporary, means of hospital isolation in the district. I pointed out to him the various sanitary needs of the parish, particularly a water supply free from suspicion, provision of proper

App. A. No. 9.

On Diphtheria at Llanfynydd; by Dr. Deane Sweeting.

means of excrement disposal in all parts of the district, means of drainage and refuse disposal, and prevention of pollution of the Sannan. With regard to water, I urged that the Authority should employ a competent engineer to advise them as to the best means of procuring a supply which shall be free from the objections attaching to that now in use.

No. 10.

EXTRACTS from a REPORT on an OUTBREAK of DIPHTHERIA, and on certain CASES of "PNEUMONIA," in the BOROUGH of FLINT; by Dr. R. J. REECE.

APP. A. No. 10.

On Diphtheria and "Pneumonia" at Flint; by Dr. Reece.

It having come to the knowledge of the Local Government Board, through the Quarterly Return of the Registrar-General, that 12 deaths had been attributed to diphtheria during the first quarter of the year 1895, in the Registration Sub-District of Flint, all of which had occurred in the Borough of Flint, I was instructed to proceed thither and make inquiry into the circumstances associated with the diphtheria.

* * * * * *

After describing the general sanitary condition of the district, Dr. Reece continues:—

It would appear that in 1894, 65 cases of infectious disease were notified under the Infectious Disease (Notification) Act, 1889. Of these, 46 were referable to diphtheria, diphtheritic croup, and diphtheritic sore throat, 8 to scarlatina, 10 to erysipelas, and 1 to typhoid fever. The first case of diphtheria in 1894 was notified on February 15th, and the second on February 16th. The first occurred in a woman aged about 34, and the second in a man aged over 40. These cases were in different parts of the town; no connexion between them was ascertained to have existed, and the source of the disease was not traced. The third case, notified on March 13th, at Pentre, was that of a boy aged 2 years. He had come from the Mold District to stay with his grandmother in the Flint Urban District, and he is supposed to have contracted the disease before his visit. He died on March 14th. The fourth case was notified on 5th May, in the person of the sister of the schoolmaster of the Pentre schools. On May 15th two children, daughters of a milkseller, were certified to be suffering from diphtheria, and on 22nd May a girl, who acted as a servant in the house of this milkseller, was attacked with diphtheria.

It is not known whether any milk was sold while these children were ill.

These cases were followed by two others, notified on 29th May and 6th June, in persons aged 41 and 10 years respectively, the child being in attendance at the National School; and on June 3rd, in another household, a woman, aged 22, was attacked. The milk supply of these families was not obtained from the milkseller mentioned above.

On June 11th and 12th two cases were notified from one family, in persons aged 16 and 9 years; the younger was attending the National School, and the milk of the family was partly obtained from the milkseller previously mentioned and partly from another source.

The next case, which appeared to have nothing in common with the previous cases, that of a woman aged 24, was notified on June 12th, after which date no further case was reported until July 14th, when a child, aged 2 years, was notified to be suffering with diphtheritic croup, which disease proved fatal on July 15th.

A considerable period elapsed before any other notifications of diphtheria were made, and it was not until 17th September that notification was received of two additional cases: one, a woman aged about 30 years; the other, a child, aged 7, who was attending the National School.

App. A. No. 10.
On Diphtheria and "Pneumonia" at Flint; by Dr. Reece.

On September 26th, F. P., aged 17, living in the same street as the child mentioned immediately above, was certified as suffering from diphtheria. She is a teacher in the Infant (Memorial) School. On the 27th a second case occurred in this house, the child, aged 10, attending the National School. Another case was notified on September 27th, of a child aged 13, living in another street, but also attending the National School.

On October 3rd a young woman, L. H., aged 17 years, was notified as suffering from diphtheria. She is a teacher in the National School, and is stated to have visited F. P., the teacher in the Memorial School, whose case has been already mentioned. Two sisters and one brother of L. H. attended the National School, and one brother the Infant (Memorial) School during the whole time of the illness of their eldest sister. I am told that the circumstance of their having illness at home was known to the school authorities.

From October 1894 until the present time (July) diphtheria has been rife in Flint.

The following table shows the attacks known to have occurred during the year 1894 and the year 1895 until July 9th :—

Month.	1894. Number of Persons known to have been attacked during the Month.	1894. Number of Deaths occurring among the Persons attacked.	1895. 1st January to 9th July. Number of Persons known to have been attacked during the Month.	1895. 1st January to 9th July. Number of Deaths occurring among the Persons attacked.
January - -	0	0	24	5
February - -	2	0	14	3
March - - -	1	1	12	2
April - -	0	0	13	2
May - - -	5	0	10	3
June - - -	5	0	14	1
July - - -	1	1	9	0
August - -	0	0	—	—
September - -	5	0	—	—
October - -	5	0	—	—
November - -	9	1	—	—
December - -	13	6	—	—
Total - -	46	9	96*	16*

* While this report was passing through the press I learnt that between the 10th and 31st of July ten cases of "diphtheria" and "diphtheritic sore throat" had been notified, and one death had been registered as due to "diphtheria."

There have thus been in a period of 18 months 142 attacks and 25 deaths, which, excluding the nine cases occurring in the first nine days of July, the result of which is not known at the time of writing, would give a death-rate of 18·8 per cent. among those attacked. The population of Flint is said to have decreased rapidly of late. Taking the population as 5,000 persons, the above figures would give an attack-rate of 28·4 per thousand, and a death-rate of 5·0 per thousand of the population from this disease alone during the period in question.

The following table gives for the same period the age incidence of attacks of the disease as far as known, and the age at death:—

—	1894.		1895. 1st January to 9th July.	
	Attacks.	Deaths.	Attacks.	Deaths.
Ages not known - - - - -	2	—	5	—
Under 3 years of age - - -	4	3	16	9
Between 3 years and 12 years - -	19	6	45	7
„ 12 „ 20 „ - -	13	—	14	—
20 years and upwards - - -	8	—	16	—
Total - - -	46	9	96	16

This table shows that the main incidence of the disease fell upon the children of the school attendance age, 3 to 12 years, and that the greater number of deaths occurred among the young children. The table also shows that adults have not been exempt. Among the latter the source of contagion has not always been traced; for the most part, however, adults have suffered subsequently to invasion of their family in the person of a child.

The following table gives approximately the number of the households invaded by diphtheria during the year 1894 and the year 1895 until July 9th, and the number of cases in each house:—

Number of cases in each house	1	2	3	4	5	6	Total Number of Houses invaded.
Number of houses invaded	64	21	6	3	0	1	95

These cases have not all occurred at one and the same time in the invaded household. In the household where six attacks occurred two cases happened in June 1894, three cases in February and one in June

APP. A. No. 10.
On Diphtheria and "Pneumonia" at Flint; by Dr. Reece.

1895. The great majority, however, of the multiple attacks in houses appear to be due to the spread of the disease from one member of the household to another.

There are five schools in the district. Within the town of Flint are the National School and the Roman Catholic School, both being "mixed" schools, and the Richard Muspratt Memorial School, attended only by children under seven years of age. There are also the Pentre-Ffwrdan School, at the hamlet Pentre Ffwrdan; and the Flint Mountain School, at the village of Flint Mountain.

The following table shows the number of children on the books and the average attendance at each of these schools during the last week of the month of April in the years 1894 and 1895:—

School.	1894.		1895.	
	No. on Books.	Average Attendance.	No. on Books.	Average Attendance.
National - - - - -	403	364	387	298
Roman Catholic - - -	178	126	190	132
Richard Muspratt Memorial (Infant)	180	156	176	129
Pentre Ffwrdan - - -	198	167	198	136
Flint Mountain - - - -	58	48	80	40

This table shows that the average attendance at all the schools has fallen off during the present year. Locally this is accounted for to a great extent by the depression of trade, but a rough census taken at the National School on the morning of my visit shows that sore throat had been prevalent to a great extent in the school. The school is divided into six classes.

National School.	No. of Scholars on the Books of the School.	No. of Scholars present at School on May 29th, 1895.	No. of Scholars present at School on May 29th who admitted having had "Sore Throat" or "Mumps" in 1895.	No. of Scholars among those present on May 29th who stayed at home on account of "Sore Throat" or "Mumps" during the first five Months of 1895.
*Class I. -	89	66	40	27
" II. -	79	75	29	22
" III. -	50	45	11	11
" IV. -	37	31	11	7
" V. -	29	22	6	3
" VI. -	67	49	16	14

* These Classes are numbered in the order in which they were inspected, and the numbers do not correspond with those in the school books.

This table also shows that there had been children attending school who were suffering from "sore throats" or "mumps." The exact nature of these ailments could not at the time of my visit be ascertained. The master had had three attacks of diphtheria as a child, and one mistress had at the time of my visit an inflamed throat and enlarged tonsils; a pupil teacher had also been laid up with a "sore throat." I examined several children in the various schools, and I found that many children had inflamed throats, enlarged tonsils, and swollen glands at the angle of the jaw. In no case, however, did I find any child actually attending school with membrane on the fauces, &c. I was particularly impressed by the number of children who were suffering from a mild form of palpebral ophthalmia. The master of the National School admitted that children with "mumps" had attended school, and that no definite steps were taken to ascertain the exact nature of the sore throats. The parent of a sick child, detained at home on account of illness, is supposed to take the child to a doctor, and the doctor's certificate to the schoolmaster; but it would appear that there are many exceptions to this rule. That children attended school from houses where diphtheria was prevailing is without doubt, as such cases came under my own observation. In one house, for instance, where a child was suffering from diphtheria and had membrane on the fauces and tonsils, two other children who had that same day attended school, one at the National School and one at the Muspratt Memorial School, were both suffering from sore throat, which had commenced after the first case of diphtheria had occurred in their house. I visited this household with the Medical Officer of Health at the time of the mid-day meal of the family. The child with the diphtheritic membrane on its fauces was being nursed at the table by its mother, who was serving the meal, and the father and a child or two sat at the table. One of the children who complained of sore throat, and had that morning attended school, was moping in the corner of the room, and the other was fetched from the back yard, common to several houses, where he was playing with his schoolmates.

In this case, as in others that came under notice, the parents admitted that the Medical Officer of Health had given instructions that the child sick with diphtheria should be kept in an upper room, and not allowed to mix with the rest of the family, and that the other children should not be allowed to attend school, and had advised as to precautionary measures and the use of disinfectants. They also admitted that they had made no attempt to carry out these instructions.

Under circumstances such as these it can scarcely be wondered at that school attendance has been the means of spreading diphtheria in Flint.

Throughout the progress of the epidemic the schools have not been closed.

Rather late in the course of the epidemic the Medical Officer of Health advocated the closing of the schools, but the Town Council did not accept this advice, the Mayor (Mr. Dyson) strongly objecting to the closure of the schools.

That the schools were instrumental in spreading the disease is shown to some extent by the diagram opposite.

It will be observed that in 1894 the Whitsuntide holidays extended from May 11th to May 21st, and that two cases of diphtheria were notified in the week ending May the 19th. The cases were really

App. A. No. 10.

On Diphtheria and "Pneumonia" at Flint; by Dr. Reece.

notified on May 15th, and the children attacked, M. E. and G. E., were sisters. The case notified in the following week was that of a servant in the E. family.

After the Midsummer vacation two cases were notified during the week ending September 22nd. One of these cases was attending the National School. Of the three cases notified during the week ending September 29th one was the teacher, F. P., in the Memorial School, and the other two attended the National School. In next week the case notified was the teacher in the National School, E. H., and her brother and sisters attended the National and Memorial Schools during her illness, as already stated.

During the first week of the Christmas vacation three cases were notified. Two of these cases occurred in adults not attending school, one apparently having been infected from her child, who had been previously attacked while attending the Roman Catholic Schools. A third case in this family was notified on January 6th, the child being in attendance at the Roman Catholic Schools. These schools were probably saved from infection by the fact that they have holiday for a fortnight in each January, and these holidays began on January 10th. No further cases appear to have been notified among the children attending these schools, though at the time of my visit in May there were numerous children with inflamed throats and enlarged tonsils, and many cases of mild palpebral ophthalmia; moreover the atmosphere was fusty, and it seemed that the ventilation might be improved.

There was a case notified on December 28th, but the case of this child appears to have been notified also on December 4th; a sister of this patient was attending the National School, and she was attacked on December 13th, having probably become infected from her brother.

Of the four cases notified during the week ending January 5th, one was above the school attendance age, two were members of families which had already been invaded by the disease, and one attended the National School.

It will be observed from the diagram that there was no break in the weekly notifications of disease during the Christmas vacation, but the cases notified during the recess can mostly be accounted for without direct reference to school attendance, though the original contagion would appear to have been derived from the schools. Also it would seem that the infection was still present among the scholars, as a child coming from a previously immune house was attacked on the seventh day after the school was re-opened.

Then followed a holiday at the National Schools from January 14th to January 17th. Previous to this holiday there had been the school examinations, during which the children had probably been aggregated together for examination purposes. During the week of this holiday the notifications on the diagram rise.

There is a gap of one week in February during which no notifications of diphtheria were received, and a rise in the number immediately before the Easter vacation. There is one case in the week ending on May 4th in the period after the vacation, and no case in the week ending May 11th. The following week diphtheria again makes its appearance, two cases attending the National and two the Pentre Schools. The Whitsuntide vacation began on May 30th and ended on June 10th. One case only was notified during the week ending June 1st, and for the following fortnight no notifications were received.

A week after the schools were re-opened there appears to have been a fresh outbreak of the disease, as shown on the diagram.

As instances of the reckless disregard of sanitary precautions among the inhabitants, the following cases may be placed on record.

A boy was notified to be suffering from diphtheria; within a few days he was about in the streets selling papers. On speaking to the boy's mother, I was told that the boy could thus earn a few pence, and the money was urgently required. No disinfection of the premises or infected articles had been attempted, the woman saying that she had put off any cleaning until the children were better.

In another house, in Swan Street, I saw a woman who had insisted on being confined in the same bed with a girl aged 10 years who at the moment was suffering from diphtheria. The girl died, but the mother and her infant did not contract the disease.

The pollution of the soil from the ill-constructed privy middens, and the consequent emanations therefrom, may to a certain extent have prepared the way for an outbreak of diphtheria by causing inflammation of the throat and fauces. Added to this, poverty and want, overcrowding of persons in houses, and lack of cleanliness would assist in lowering the bodily vitality and the resisting power against disease.

To the attendance of children at school from infected houses, and possibly even of children while suffering from diphtheria, to the absence of any attempt at efficient isolation of those attacked, and to the absence of any method of thorough disinfection of infected articles and premises; and to the ignorance, carelessness, and apathy of the inhabitants; may be attributed the continued prevalence of the disease in the Flint Urban District.

Before closing this report it may be as well to put on record a few facts concerning an outbreak of "pneumonia" to which my attention was directed while investigating the facts of the diphtheria outbreak. Unfortunately, although I made a second visit to Flint for the purpose, I did not succeed in seeing a case. To the medical men practising in the locality, and to the registrar of deaths, I am indebted for much of the following information:—

The disease first made its appearance in February, while the population was still suffering severely from privation and want, and while the town was undergoing a visitation of an epidemic of influenza. All the signs of typical pneumonia were present in most cases, the temperature rapidly rising, and remaining at 104° or 105° F. There appeared to have been rusty expectoration from the very onset of the disease, and death, when a case had a fatal termination, generally took place in the first week of the attack, and usually within the first four days. In some cases the extent of the pneumonic dullness was hardly as large as a man's hand, and situated high up in the lungs. One medical practitioner told me that the amount of thoracic dullness and the physical signs of pneumonia were not in his opinion sufficient to warrant an unfavourable prognosis, but the patient would die in a few hours apparently without any attempt to rally. There would appear to have been no noisy delirium, and no rash was observed. Mr. Hughes, of Flint, who was practising in Flint during the typhus epidemic in 1887, and whose partner, the then medical officer of health, died from that disease, told me that in his opinion the "pneumonia" was unlike typhus in its clinical aspects.

The first three cases occurred in one house. A young man, J. E., aged 25, was attacked, and died in a few days. He was a miller by trade, in receipt of good wages. His mother, a woman of 62, who was

in feeble health, came to nurse him, and died on the day of his funeral. A week later, an old man, aged 70, who was living in the same house as the previous cases, also died after an illness of four days' duration. His death certificate was signed "(Typhoid) Fever, Exhaustion," but the medical practitioner in attendance told me "pneumonia" was the immediate cause of death.

I made an attempt to ascertain whether the young man first attacked had been in any way exposed to the contagion of typhus fever, but I could elicit no information bearing on the point. The house J. E. lived in is kept by a respectable old man and his wife, and neither of them, or the two sisters of J. E., who came to nurse their brother and mother, suffered from any illness at this time. The house was clean.

The cases following this batch were scattered widely about the town, and did not seem to the Medical Officer of Health, who attended the majority of them professionally, to have any direct relation one with the other. Of the later cases, however, some four occurred within 50 yards or so of one another; one being in the Flint Urban District, and three in the Holywell Rural District, and of these latter cases two were members of one family; one, a female aged 32, being first attacked, and dying on June 24th, within a week of her attack; and the other, her younger sister, aged 15, who died on June 28th, having nursed her elder sister, and apparently contracted the disease from her.

There would appear to be certain infective properties in this disease, though whether it is an "infective pneumonia" or "typhus fever" I am not prepared to say. The local medical opinion is opposed to the idea of "typhus fever."

I ascertained from the medical men practising in the district that about 35 cases of this form of pneumonia had occurred, also that there had been several deaths from "pneumonia" following as a sequela to influenza. I append a list of the deaths notified as due to "pneumonia," "pneumonia after influenza," and a case of "bronchitis" (No. 18), which was probably one of the series of "infective pneumonia," in the view of the medical man who had charge of the case. Leaving out of the list cases of which there is any doubt, the average age of those dying of the disease would be about 41 years, and of those attacked about 34 years.

Table showing the Number of Deaths registered as due to "Pneumonia" and allied Lung Disorders in the Flint Urban District and the adjoining Parish of Northop, with the Age, Sex, and Residence of those dying of the Disease in the Year 1895, from 1st January to 9th July inclusive.

No. of Case.	Date of Death.	Address.	Sex.	Age in Years.	Occupation.	Certified Cause of Death.
1	Feb. 2	Mount Pleasant -	M.	25	Miller - -	Pneumonia.
2	" 8	" -	F.	62	Widow. Mother of No. 1.	"
3	" 15	" -	M.	70	General labourer -	(Typhoid) fever, exhaustion. (Pneumonia was the immediate cause of death.)

No. of Case.	Date of Death.	Address.	Sex.	Age in Years.	Occupation.	Certified Cause of Death.
4	Feb. 23	Pentre - -	F.	41	Housewife -	Pneumonia.
5	March 6	" - - -	M.	51	Chemical labourer -	"
6	" 8	Upper Queen Street	F.	49	Housewife -	Pleuro-pneumonia.
7	" 10	Swan Street -	F.	23	?	Influenza, pneumonia.
8	" 10	Roskell Square -	M.	19	Seaman.	——
9	" 16	Commercial Road -	F.	18 mos.	None - - -	Broncho-pneumonia.
10	" 20	Castle Dyke Street -	M.	35	Chemical labourer .	Pleuro - pneumonia, exhaustion.
11	" 21	The D—— Hotel -	F.	54	Widow - -	Influenza, inflammation of both lungs.
12	" 28	Mount Street -	M.	79	Sawyer, journeyman	Pneumonia.
13	April 11	Pen-y-Glyn - -	F.	57	Spinster - -	Influenza, pneumonia.
14	May 7	Sydney Street -	M.	31	Chemical labourer -	Inflammation of right lung, eight days. Inflammation of left lung, four days.
15	" 16	Mumforth Street -	M.	16	?	Pneumonia.
16	June 11	Oakenholt, Flint U.D.	M.	46	Agricultural labourer	Pneumonia, heart failure.
17	" 24	Oakenholt, Northop	F.	32	Employed in paper mill. Sister of No. 19.	Pneumonia, syncope.
18	" 25	Paper Mill Cottages, Northop.	F.	16	Employed in paper mill.	*Acute bronchitis, exhaustion.
19	" 28	Oakenholt, Northop	F.	15	Employed in paper mill. Sister of No. 17.	Anæmia, catarrhal pneumonia.
20	July 9	Waen Issa, Flint U.D.	M.	44	Coal miner - -	Pneumonia, six days. Heart failure.

* Probably pneumonia.

Recommendations.

Isolation Hospital.—Hospital accommodation for persons suffering from infectious disease, and suitable means of transport thereto, should be provided by the Flint Town Council.

They should also provide means for proper disinfection of clothing, bedding, &c.

Water Supply.—The Town Council should, without delay, take the steps necessary for securing to each dwelling in the district a sufficient supply of wholesome water.

Disposal of Excrement and Refuse.—An inspection of the privies in the district should be made, and those which are found to be a source of nuisance should be reconstructed in accordance with the Town Council's byelaws. The contents of the privies and ashpits should be removed not less seldom than once a week; and the present objectionable method of removal should be abolished, for one under which the contents of these receptacles shall be removed directly to the carts in place of being first deposited in the roadways.

Dairies and Cowsheds.—The attention of the Town Council should be directed to the necessity for the due regulation of the cowsheds and dairies in their district.

Paving of Courts and Yards.—The Town Council should avail themselves of the provisions of section 23 of the Public Health Acts Amendment Act, 1890, for securing paving of yards and open spaces in connexion with dwelling-houses.

Action in Regard to Nuisances. — Inspection of the district for the discovery of nuisances should be carried out thoroughly and systematically, in accordance with section 92 of the Public Health Act, 1875.

Nuisances should be sought out, and the provisions of the Public Health Act for their repression should be enforced independently of complaints from inhabitants. Nuisances likely to recur should be specially dealt with under section 95 of the above-mentioned Act.

Half holiday	February 26th		
Easter Vacation	April 10th " 16th	Easter Vacation	April 11th to April 22nd
		Half holidays - School concerts	April 30, May 1st
Church holiday	May 23rd		
Whitsuntide Vacation	May 31st to June 10th	Whitsuntide Vacation	May 30th to June 10th
Church holiday	June 13th		
		Half holiday. Ladies club	July 2nd
		* These dates apply to all the Schools with the exception of the Roman Catholic Schools.	

1895

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No. 11.

REPORT on an OUTBREAK of EPIDEMIC SKIN DISEASE in the ENFIELD WORKHOUSE of the EDMONTON UNION; by Dr. S. MONCKTON COPEMAN.

In consequence of a report received from the Medical Officer to the Enfield Workhouse, to the effect that an outbreak of skin disease, apparently similar to those which have recently occurred in several of the Metropolitan workhouse infirmaries, had broken out in the institution under his charge, I received instructions from the Board to visit the workhouse and to investigate the circumstances of the outbreak. I found that at the date of my visit 26 cases had come under treatment, of which the first was detected on the 9th April of the present year (1895). I further found that there was no special "infirmary" in connexion with this workhouse, all the inmates being more or less infirm, but that one small block and two or three other wards were set apart for such cases as were specially ill.

At the date of the occurrence of the first case of this disease, the inmates of the establishment numbered 158, of whom 92 were of this special class.

In the first place I visited the various wards, accompanied by the Medical Officer, Dr. Collyer, with a view to examine the cases which at the time were under treatment, and to satisfy myself that they were really of a similar nature to those which I had previously met with in other Poor-law institutions.

As the result of such visit, I have no doubt that the malady from which the patients were suffering was that which, in my former report, has been spoken of as "epidemic skin disease."

I learnt from the Medical Officer that the onset of the disease was very uniform in the several cases, gastric symptoms—including a coated tongue, nausea, loss of appetite, and in some cases actual vomiting—having preceded. by a longer or shorter interval, the appearance of the rash. The rash itself appeared in every instance to have been preceded by irritation, and a sense of heat and tingling of that portion of the skin whereon the rash subsequently appeared. The subjective symptoms subsided slightly before the rash itself appeared. In most instances the rash first appeared on the arms and hands, soon, however, manifesting itself on other portions of the body. In some few cases only, the rash commenced on the head about the temporal regions, and gradually extended thence over the limbs and trunk. In yet a few other cases the disease made its first appearance on the soles of the feet. In the further progress of the cases the same distinction was noticeable between a "moist" and "dry" variety as had been witnessed in previous outbreaks of the malady. In a large proportion of the cases the rash was followed after a longer or shorter period by copious desquamation. Unfortunately, however, no clinical notes or temperature charts had been kept, so that it was impossible to say in any instance whether the onset of the disease had been accompanied by pyrexia or other special symptoms.

Cause of the Outbreak.

As in my former investigations, I made inquiries into the circumstances, not only of the persons who had suffered attack by the disease, but also of those other persons living in the house who had not become attacked, in order to find out if possible the cause or causes which had

App. A. No. 11.

On "Epidemic Skin Disease" in Enfield Workhouse; by Dr. Copeman.

brought about the epidemic. With one or two exceptions, all the persons attacked were of advanced age, and sufferers also from chronic disease of one kind or another. The disease had attacked a number of these persons in the first instance almost concurrently, although they were at that time distributed over several different sick wards. Of these, the female wards are in direct communication with the main building, while the male sick wards, on the other hand, are isolated from it. There is thus, ordinarily speaking, no communication between these two sets of wards, excepting that the nurses on duty in either block necessarily meet, from time to time, in their mess-room or in the surgery. As in former outbreaks in other Poor-law infirmaries, I was able to eliminate irritation of the skin due to soap, to coarse body clothing, and to newly-died and unwashed bedding from having had concern with the outbreak. As far as I was able to learn, there existed no possibility of infection having been brought personally to the patients from outside the institution. The sanitary surroundings of the patients, too, were very similar in all the different wards. Only when the question of diet came to be considered did there appear a basis whereon distinction could be made between the circumstances of those who had suffered attack and those who had escaped the disease.

On going carefully into this subject, it appeared that of the various articles of food and drink contained in the dietaries of the various inmates of the institution, only two were in common use among all the persons who had suffered attack, namely, milk and bread. The bread, baked on the premises, and believed to be of good quality, had been, however, supplied equally to all the inmates of the institution, whereas the milk had been (with the exception of the small amount supplied in tea) only served to the patients in the various sick wards. It is true that two cases of the disease occurred among the more or less able-bodied inmates of the house proper, into whose diet milk does not enter; but, on fuller and detailed inquiry, it was found in each instance that these particular persons had been consuming a certain amount of milk. One, a man named H——, who had been employed each day to carry the supply of milk to the female side of the building, had not only received some from the nurse each day for his trouble, but had, he confessed, from time to time abstracted a still further portion. The other case, a woman named B——, who had been on No. 2 dietary,* had also, I found, been receiving a special allowance of milk to the extent of one pint a day. With the exception of these two, no case occurred from first to last among those persons living in any part of the workhouse other than the sick wards. On inquiry of the master, I learned that in April, when the epidemic commenced, the contractors for the milk supply were Messrs. A——, the same firm which had been supplying the other Poor-law institutions on which I have reported in connexion with former outbreaks of a similar character. I further learnt that the contract with this firm dated from the previous quarter-day. Their milk had, however, actually been supplied to the workhouse since March 31st only, previous to which date milk had been obtained from Mr. H——, a local dealer. One of the nurses informed me also that a day or two after the new contract had come into force the milk supplied to her ward had, she noticed, a peculiar smell, although in other respects she had not considered it of bad quality. So peculiar, indeed, had been the smell of the milk at this particular time, she said, that a number of the patients refused to drink it. The matter had not,

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* *See* Addendum.

however, come under the notice of the master, as no milk is ever returned from a ward, any portion of the day's supply which is unused being thrown down the sink. Examination of the milk was not made at this time, but about a fortnight later a chemical analysis of that supplied in ordinary course to the institution was ordered by the Guardians. No information of importance, however, was thus obtained. No bacteriological examination of the milk was at any time made.

As already stated, the new milk supply came into force on March 31st, and the first case of the disease appeared on April 9th, an interval of about 10 days, which coincides with that observed under a similar set of circumstances at the St. George's-in-the-East Infirmary in the previous year, 1894, where also, curiously enough, the same firm had the milk contract.

The time incidence of the disease is shown in the following table, in which the number of cases occurring on any one day is set down opposite that particular date :—

April 9th, 1895	1 case.
" 15th, "	2 cases.
" 20th, "	3 "
" 28th, "	1 case.
May 6th, "	3 cases.
" 12th, "	15 "
" 21st, "	1 case.
" 24th, "	2 cases.

From this latter date up to the present time, October 1895, no further cases of the disease have been observed.

On the first appearance of cases of this skin disease in the institution, the Medical Officer thought that they might possibly have arisen from want of a sufficient amount of vegetable food in the dietary of the inmates. Accordingly alteration was made in this respect, but nevertheless the disease continued to occur. His further investigation into the circumstances and the dietary of the persons affected having shown that these persons differed from the majority of the inmates solely in the fact that in their dietary was included a not inconsiderable quantity of milk, whereas persons not in the infirmary received a trivial quantity only in their tea, the Medical Officer made a note of this in his report book for the information of the Guardians, and at the same time arranged with the master that the contractors' milk should not for a time be supplied to the inmates. Accordingly on May 24th the master cut down the supply from Messrs. A——, the contractors, from an average of 79 quarts to 22 quarts per diem, and ordered 20 quarts from a local dealer. None of Messrs. A——'s milk, however, was now used in the establishment, the whole of it being given to the pigs, the deficiency being met by the use of condensed milk. This state of affair continued until June 9th, on which day, as he had received no instructions from the Guardians, the master again commenced the use of the contractors' milk in the institution, and two days later, on June 11th, he wrote to the local milkman above referred to to terminate the arrangement made with him.

It was on this same day, June 11th, that I paid my first visit to the institution, and obtained the information set out above. As the result of my own investigation of the matter, I came to the conclusion, as I have already stated in this report, that good reason existed for suspecting that the milk supplied by the contractors had indeed, in some way or other, been concerned in the outbreak of epidemic skin disease in the workhouse. This being so, I demurred to any new experiment

App. A. No. 11.

On "Epidemic Skin Disease" in Enfield Workhouse; by Dr. Copeman.

being made on the inmates, however interesting the results of such experiment might promise to be from an etiological or pathological point of view. At my suggestion, therefore, the master immediately made arrangements for all the milk to be obtained from a local dealer; and although, without instructions from the Guardians, he was unable to stop the contract supply altogether, he wrote to Messrs. A—— to send only four quarts of milk a day, which amount, as had been the case before with a larger quantity, was administered, as he afterwards informed me, to the pigs.

In due course the Guardians were informed of this arrangement, and eventually they, with the consent of the Local Government Board, terminated Messrs. A——'s contract as from the 10th August 1895, and without remonstrance on the part of the contractors.

The last two cases of the skin disease which occurred at this institution broke out on May 24th, the day on which use of the milk from Messrs. A—— was, as I have said, discontinued. Whether there was relationship of effect and cause between these two circumstances, cessation of the outbreak and discontinuance of Messrs. A——'s milk, it is of course extremely difficult to say; the more since it is impossible to affirm that the epidemic was not, by this date, already on the wane.

To sum up:—In all, 92 persons, into whose diet milk, as such, entered, were each in receipt of a daily allowance to the extent of one pint or more a day, and of these 92 persons 26 are known to have suffered attack by the disease.* Of the remaining 66 persons, making up with the 92 the total of 158, in the institution (excluding members of the staff), only two had an allowance of milk, other than the small quantity given in tea, and these two persons were alone of the other inmates affected. Although not condemned by chemical analysis, the milk supplied by Messrs. A—— is stated to have had a peculiar smell, which was specially noticeable a few days after their contract came into force, and on microscopic examination specimens of it showed, according to Dr. Gardner, the Assistant Medical Officer of the institution, in addition to the fat globules and a few epithelial scales, "certain " groups of granular matter, blood-red in colour; nucleated corpuscles " answering to the description of pus cells, and two different kinds of " organisms, one rod-shaped and jointed, the other occurring as " cocci, and also united to form chains." As, however, this examination was made on May 21st, little stress can be laid on it as bearing on the condition of the milk just previous to the time at which the first cases of the disease made their appearance.

* In addition to these cases, however, there were, as I afterwards learnt from Dr. Collyer, a number of inmates of the female sick wards (14 in all) who, during the period at which the epidemic was at its height, suffered from irritation of the skin, with sensation of heat and tingling, accompanied by the gastric symptoms; symptoms, that is, by which the epidemic skin disease is usually ushered in. At no period, however, of the malady did these persons exhibit obvious rash. Twelve of these cases occurred in the wards of which Nurse Lake was in charge, the remaining two in Nurse Clarke's wards. It is impossible to give the exact dates on which these persons first exhibited the symptoms in question, but they all came under notice between May 6th and 12th, 1895. At this time they were all, without exception, on a dietary which included milk.

These anomalous cases correspond very closely in character with doubtful cases which I have described in a former report as having occurred at St. George-in-the-East Infirmary during the prevalence in that institution of an outbreak of epidemic skin disease.

ADDENDUM.

Enfield Workhouse.

Cases of Epidemic Skin Disease.

Name.	Age.	Date of Admission to Sick Ward.	Disease.	Diet.	Extras.
B., Eliza -	35	21.10.94	Debility - -	2	1 pint milk.
R., Elizabeth	71	24.4.90	Senectus -	2	" " 1 egg.
W., Sarah -	70	12.8.93	Ulcer - -	2	" "
L., Lydia -	66	25.3.94	Struma - -	2	" " 1 egg, 1 pint porter, 1 lemon.
W., Louisa -	37	21.5.93	Debility - -	3	——
L., Cecilia -	53	20.10.94	" - -	2	1 pint porter.
F., Sarah -	85	11.11.94	Lumbago - -	2	" milk, 1 egg, 1 lemon.
Br., Harriet	68	24.2.93	Eczema - -	2	1 pint porter.
M., Susan -	86	1.7.93	Senectus - -	6	" milk.
L., F. - -	77	11.10.93	" - -	2	" " ½ porter.
W., Hannah	71	25.3.94	Debility - -	2	" " "
W., Ellen -	77	18.11.94	Mental - -	2	" "
B., Harriet -	80	4.1.95	Bronchitis -	6	" "
H., Benjamin	68	27.1.95	Debility - -	1	" porter.
E., F. - -	80	27.7.91	Senectus - -	6	" milk.
F., Isaac -	77	12.7.93	Epilepsy - -	2	" "
Gr., Samuel	71	3.4.92	Gout - -	2	" " 1 pint porter.
Gf., Jesse -	72	10.4.93	Rheumatism -	2	" "
G., George -	76	23.3.94	Senectus - -	2	" "
A., John -	79	19.9.94	" - -	3	——
C., Alfred -	77	27.1.95	Facial paralysis	2	1 pint milk.
L., Robert -	71	12.2.95	Debility - -	2	" "
N., William -	75	18.2.95	" - -	2	" "
G., Thomas -	64	26.2.95	Influenza - -	3	——
A., George -	79	3.3.95	" -	2	1 pint milk.
M., James -	61	23.4.95	Fracture - -	2	" "
C., Louisa	74	12.5.95	Senectus - -	2	" "
E., Thomas -	86	24.5.95	" - -	3	1 pint porter.

TABLE I.—Under care of NURSE LAKE. (Females.)

Name.	Date of Eruption.	Diet at same Period.	Ward.
L., Lydia - -	April 9th - -	No. 2 and milk -	12
F., Sarah - -	„ 20th - -	„ 6 „ 1 egg	13
W., Louisa -	„ 20th - -	„ 3 „ - -	13
B., Eliza - -	„ 20th - -	„ 2 „ - -	Body of House.
R., Elizabeth -	May 6th - -	„ 2 „ 1 egg	15
W., Sarah - -	„ 6th - -	„ 6 „ - -	13
L., Cecilia -	„ 12th - -	„ 2 „ porter	15

TABLE II.—Under care of NURSE CLARKE. (Females.)

Name.	Date of Eruption.	Diet at same Period.	Ward.
B., Harriet -	May 6th - -	No. 6 and milk -	9
Br., Harriet -	„ 12th - -	„ 2 „ porter	11
C., Louisa -	„ 12th - -	„ 2 „ -	7
W., Ellen - -	„ 12th - -	„ 2 „ - -	11
L., Frances -	„ 12th - -	„ 2* „ -	11
M., Susan - -	„ 12th - -	„ 6 „ - -	7
W., Hannah -	„ 21st - -	„ 2 „ - -	11

TABLE III.—Under care of NURSE STANTON. (Males.)

Name.	Date of Eruption.	Diet at same Period.	Ward.
N., William -	April 15th - -	No. 2 and milk -	32
L., Robert - -	„ 15th - -	„ 2 „ -	26
Gf., Jesse -	„ 28th - -	„ 2 „ - -	26
A., John - -	May 12th - -	„ 3 „ -	33
M., James - -	„ 12th - -	„ 2 „ - -	32
E., Frank -	„ 12th - -	„ 6 „ -	27
G., George -	„ 12th - -	„ 2 „ - -	27
Gr., Samuel -	„ 12th - -	„ 2 „ porter	33
F., Isaac - -	„ 12th - -	„ 2 „ -	27
A., George -	„ 12th - -	„ 2 „ - -	33
G., Thomas -	„ 12th - -	„ 2 „ -	33
C., Alfred - -	„ 12th - -	„ 2 „ - -	26
H., Benjamin -	„ 24th - -	„ 1 „ -	Body of House.
E., Thomas -	„ 24th - -	„ 3 porter - -	26

Enfield Workhouse.

Dietary for the Sick, as per Medical Relief Book.

June 1895.

No. 1.—House Diet, being the ordinary diet for paupers in the workhouse.

No. 2. Full Diet.	Breakfast.			Dinner.			Supper.		
	Bread.	Tea.	Butter or Dripping.	Bread.	Meat.	Vegetables.	Bread.	Tea.	Butter or Dripping.
	Ozs.	Pts.	Oz.	Ozs.	Ozs.	Ozs.	Ozs.	Pints.	Oz.
Males -	6	1	½	3	5	8	5	1	½
Females -	5	1	½	3	4	8	4	1	½

No. 3. Low Diet.	Breakfast.			Dinner.			Supper.		
	Bread.	Tea.	Butter or Dripping.	Bread.	Beef Tea.	Milk.	Bread.	Tea.	Butter or Dripping.
	Ozs.	Pts.	Oz.	Ozs.	Pints.	Pints.	Ozs.	Pints.	Oz.
Males -	6	1	½	4	1	1	6	1	½
Females -	5	1	½	3	1	1	5	1	½

No. 4. Convalescent Diet.	Breakfast.			Dinner.				Supper.		
	Bread.	Tea.	Butter or Dripping.	Bread.	Fish or Meat.		Vegetables.	Bread.	Tea.	Butter or Dripping.
	Ozs.	Pts.	Oz.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Pts.	Oz.
Males -	6	1	½	4	12	5	8	5	1	½
Females	5	1	½	3	12	4	8	4	1	½

No. 5.—The same as No. 4, with the exception of having a chop for dinner.

App. A. No. 11.

On "Epidemic Skin Disease" in Enfield Workhouse; by Dr. Copeman.

No. 6.	Breakfast.			Dinner.			Supper.		
	Bread.	Tea.	Butter or Dripping.	Bread.	Beef Tea.	*Rice, Tapioca, or Sago Pudding.	Bread.	Tea.	Butter or Dripping.
	Ozs.	Pts.	Oz.	Ozs.	Pint.	lb.	Ozs.	Pints.	Oz.
Males -	5	1	½	3	½	½	4	1	½
Females	4	1	½	2	½	½	8	1	½

* Made as follows:—One oz. rice, tapioca, or sago, one egg, ½-oz. sugar, ½-pint milk.

No. 12.

App. A. No. 12.
On an Inspection of certain Valleys in South Wales; by Mr. T. W. Thompson.

REPORT upon an INSPECTION of certain VALLEYS in the Counties of MONMOUTH and GLAMORGAN, with special reference to SEWERAGE and DRAINAGE ARRANGEMENTS, and to the POLLUTION of STREAMS; by MR. T. W. THOMPSON.

In July 1895, I received instructions to carry out an inspection, which the Board had for some time had in contemplation, of the Valleys of the Rumney, Sirhowy, Ebbw Fawr, Ebbw Fach, and Ebbw Rivers; and somewhat later my inspection was extended, by fresh instructions, to the Valley of the Afon Llwyd. The object of this inspection was to ascertain more precisely the existing state of affairs—already known to be of a generally unsatisfactory character—as regards drainage and sewerage arrangements in these valleys; both in respect of their general suitability to fulfil their purposes and with special reference to the pollution of streams. It was further understood that I should keep in mind the question as to the best means of remedying such defects of sewerage and of sewage disposal as might be met with.

The results of my inspection are given in the following Report:—

GENERAL REPORT.

Topographical and General Description of the Valleys.—Speaking generally, the valleys in question may be said to extend in a south-easterly direction from the southern slope of the elevated plateaux in the south of Brecknockshire, known as the Llangynidr and Pen Cern Mountains. The Sirhowy, Ebb Fawr, Ebbw Fach, Ebbw, and Afon Llwyd Valleys lie wholly within the county of Monmouth, on its western side, except that for a short distance at their commencement the two former are situate in the county of Brecknock. The Rumney Valley also commences in Brecknockshire, but for the remainder, *i.e.*, almost the whole of its course, its western side is situate in the county of Glamorgan and its eastern side in that of Monmouth, the Rumney river constituting the boundary between these counties. The Rumney Valley follows an independent course throughout, its river discharging separately into the Severn estuary at the eastern boundary of the borough of Cardiff. The valleys of the Ebbw Fawr and Ebbw Fach, after each pursuing a separate course for some six or seven miles, unite at Aberberg, by the confluence of their rivers, to form the valley of the main River Ebbw. At Risca, about eight miles further south, the Ebbw Valley is joined by the Sirhowy Valley; the Sirhowy river at this point joining the Ebbw, which ultimately discharges into the River Usk, close to the confluence of the latter with the Severn. The Afon Llwyd follows an independent course until its river joins the Usk at Caerleon.

App. A. No. 12.

On an Inspection of certain Valleys in South Wales; by Mr. T. W. Thompson.

For a considerable part of their extent the valleys are narrow and flanked by steep mountain ridges, which rise to an elevation, in some localities, of 800 feet or more above the level of the rivers. Towards the south-east, however, below Caerphilly, Risca, and Pontypool, the valleys of the Rumney, Ebbw, and Afon Llwyd, respectively, open out, and the country, though still hilly in places, becomes gradually less so.

Rivers.—The course of the several rivers has been generally indicated in the above account of the valleys, and may be seen by reference to Diagram A. accompanying this Report. They are all rapid and for the most part shallow streams. The approximate length of each is as under:—

The Rumney - - - - -	29 miles.
The Sirhowy - - - - - -	19 „
The Ebbw Fawr - - - -	7 „
The Ebbw Fach - - - -	7 „
The Main Ebbw (from Aberberg southward)	15 „
The Afon Llwyd - - - -	16 „

Taken together these rivers pass through or along the boundaries of 23 different sanitary districts, the arrangement of these districts in relation to the rivers being, from north to south, as follows:—

THE RUMNEY RIVER.

West Side.	*East Side.*
Gelligaer, Rural.	Rumney, Urban.
Caerphilly, Urban.	Bedwellty, Urban.
Llandaff and Dinas Powis, Rural.	St. Mellons, Rural.
Cardiff, Urban.	

THE SIRHOWY RIVER.

West Side.	*East Side.*
Tredegar, Urban.	Tredegar, Urban.
Bedwellty, Urban.	Bedwellty, Urban.
St. Mellons, Rural.	St. Mellons, Rural.
Risca, Urban.	Risca, Urban.

THE EBBW FAWR RIVER (TO ABERBERG).

West Side.	*East Side*
Ebbw Vale, Urban.	Ebbw Vale, Urban.
Abercarn, Urban (for short distance at extreme south).	Abertillery, Urban (also for short distance).

THE EBBW FACH RIVER.

West Side.	*East Side.*
Nantyglo and Blaina, Urban.	Nantyglo and Blaina, Urban.
Abertillery, Urban.	Abertillery, Urban.

The Main River Ebbw (below Aberberg).

West Side.	*East Side.*
Abercarn, Urban.	Abertillery, Urban.
Risca, Urban.	Abercarn, Urban.
St. Mellons, Rural.	Risca, Urban.
	St. Mellons, Rural.
	Newport, Urban.

The Afon Llwyd River.

West Side.	*East Side.*
Blaenavon, Urban.	Blaenavon, Urban.
Abersychan, Urban.	Abersychan, Urban.
Pontypool, Urban.	Pontypool, Urban.
Panteg, Urban.	Panteg, Urban.
Llanfrechfa Upper, Urban.	Pontypool, Rural.
Llantarnam, Urban.	Magor, Rural.
Magor, Rural.	
Caerleon, Urban.	

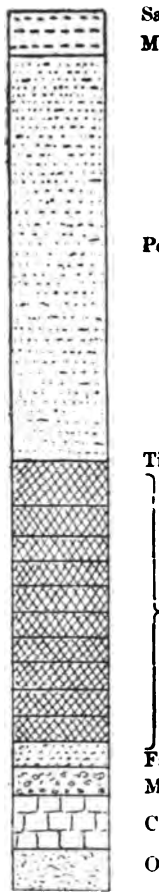
In traversing the above districts, the several rivers receive a number of tributary streams, which will be seen, later, to be of considerable importance from the point of view of river pollution. Among the most important of these streams are the Bargoed Rumney and the Aber and Cledr Brooks, which discharge into the Rumney; the Cwm Tillery, which discharges into the Ebbw Fach; the Torlas Brook, which discharges into the main River Ebbw; and the Cwmffrwd, Sychnant, Cwmnantddu, Cwmffrwdoer, Trosnant, and Cwmbran Brooks, which discharge into the Afon Llwyd.

Geology.—The geological circumstances of the region under consideration have important bearing upon certain of the questions to be referred to in this Report, and must, therefore, be stated in some detail. The point to be first observed is, of course, the large portion of the region which is situate upon the Coal Measures of the South Wales coalfield. This valuable coalfield extends from Kidwelly, in Carmarthenshire, on the west, completely through Glamorganshire and into Monmouthshire as far as the Afon Llwyd Valley, which, roughly, marks its extreme eastern limit. The eastern portion of this coalfield, with which alone I am concerned, extends uninterruptedly from west to east, across the Rumney, Sirhowy, Ebbw Fawr, and Ebbw Fach Valleys, to the west side of the Afon Llwyd Valley. From north to south it stretches from a little beyond the Monmouthshire boundary in the north to Risca and Caerphilly in the south, a distance of between 15 and 16 miles. As regards the geology of the remainder of the area covered by these valleys, the limit of the coalfield is everywhere marked by the outcrop of the Millstone Grit and Carboniferous Limestone which underlie the Coal Measures, while the Old Red Sandstone, which lies

deeper still, is exposed over nearly the whole remaining portion of the area under consideration.

The general arrangement of the strata in this eastern portion of the coalfield is indicated by the diagram below, which represents a section of the locality known as the Caerphilly Basin.

The strata there comprise from above downwards:



The Rumney, Sirhowy, and the Ebbw Valleys have been carved by their respective rivers through the upper sandstone of the Coal Measures, and for a considerable depth through the Pennant rock. The Afon Llwyd Valley, on the other hand, has been cut between the Pennant rock and the Millstone Grit and Limestone. In the bottoms of the valleys the rock is for the most part completely masked by glacial gravels, varying in character from a clay full of stones to a pebbly gravel, as well as by the washing down of disintegrated rock, shale, and sandstone which, in places, has accumulated to considerable depth, forming alluvial meadows along the sides of the rivers.

With regard to the coal, the Mynyddislwyn vein of house coal, with its overlying sandstone and shale, has long since been extensively removed by denudation, though it still exists in the Caerphilly Basin, and over a considerable area near the centre of the Monmouthshire

portion of the coalfield, where it has, however, already been largely worked. But the importance of the coalfield, of course, depends upon the number and value of the deeper seams of steam coal. These seams, which crop out along the north of the coalfield, rapidly become deeper on proceeding southwards, owing to the dip in the strata, and attain in some localities, about the centre and towards the lower part of the coalfield, a depth of over 700 yards. Further south, however, the strata are again raised into an anticlinal ridge, as may be seen from the re-appearance of the Millstone Grit and Limestone, and the coal is thus brought nearer to the surface.

Similarly the steam coal comes to the surface along the western side of the Afon Llwyd Valley.

Population and Occupations of the People.

It will be readily understood that the area to which this Report refers, which may be roughly taken as co-extensive with the urban and rural districts enumerated on pages 102 and 103 (exclusive of the boroughs of Cardiff and Newport and the urban district of Caerleon, which are not really within the drainage area under consideration), is, from an industrial point of view, a highly important one, and is already occupied by a large population. According to the census of 1891, the population of the sanitary areas, and parts of sanitary areas, here dealt with then amounted to 175,432, showing an increase of nearly 19 per cent. upon the census of 1881. These persons, who are mainly engaged in the coal, iron, and allied industries, are distributed chiefly in a number of towns which have arisen in the neighbourhood of past and present workings. It was natural, of course, that in the first instance the coal and ironstone should be worked where they were nearest to the surface, and accordingly the chief centres of population are for the most part situate at or near the circumference of the extensive basin formed by the anticlinal arrangement of the Coal Measures, to which reference has already been made. The chief instances in point are the towns of Rhymney, Tredegar, Ebbw Vale, Nantyglo and Blaina, Blaenavon, Abersychan, Pontypool, Risca, and Caerphilly, where the numerous shale heaps of abandoned workings afford ample evidence that in most of these localities mining, though chiefly of a superficial sort, has been carried on for a very long period. The tendency, however—a tendency which has already manifested itself in several localities—is to extend the workings toward the centre of the basin, where the coal lies deeper. As the coal becomes gradually worked out at the surface, this tendency will become more pronounced, and new and extensive centres of population will doubtless arise in neighbourhoods which are at present of a rural character.

As regards the present state and prospects of the industries of this region, the iron trade is undoubtedly in a very depressed condition, and not a few of the most important ironworks have, it would seem, been permanently closed. There are doubtless various reasons for this depression. The original development of the important iron industry in this locality was, of course, mainly determined by the abundance of clay ironstone in the Coal Measures. Owing to the amount of phosphates present in this local ore, however, it is unsuitable for modern methods of steel manufacture, and foreign ore is consequently now almost exclusively used. Hence ironworks situate on the seaboard have advantage over those further inland. In another respect the introduction of steel has indirectly conduced to the depression, temporarily

at all events, of the iron trade in this locality. Much of the trade formerly consisted of the manufacture of iron rails, the average life of which is about four or five years, whereas that of a steel rail appears to be some 15 or more years. Other things being equal, this, of course, would considerably diminish the demand for iron rails; but I am further informed that the introduction of steel rails attracted so large an amount of capital to their manufacture that a serious over-production of steel rails ensued. On the whole, the prospects of the iron and steel industries, along the north of these valleys at all events, appear to be generally regarded as far from reassuring. Whether any important development of these trades is likely to occur in the south of the valleys nearer the seaboard is another question. Certainly some nine years ago some large iron and steel works were removed from the Midlands to Rogerstone, in St. Mellons Rural District, a few miles north of Newport, and some new blast furnaces have recently been erected at the works of the Patent Nut and Bolt Company, in the Llantarnam Urban District.

Another important industry in these valleys, the tin-plate trade, is also in a depressed condition, though at the time of my visit there were some signs of its revival; one or two works which had been temporarily closed had just been re-opened. How far the prospects of this industry will be permanently injured by foreign tariff regulations remains to be seen.

The most important industry is, however, of course, coal-mining, the ultimate prospects of which in this region appear to be particularly good. It is true that a considerable amount of the coal has already been worked at the outskirts of the basin where it is nearest the surface; in the Nantyglo and Blaina district, for instance, it is considered by persons whose local knowledge and experience would seem to entitle their opinion to respect, that the coal, at the present rate of working, will be worked out in from 20 to 30 years. A similar estimate was given to me in regard to the coal in the Blaenavon Urban District. These, however, are the districts in which the coal has been most extensively worked. On the other hand, it is certain that over the greater part of the eastern region of the South Wales coalfield there is a vast amount of coal still to be worked. This coalfield would indeed appear, as I was informed on very high authority, to be only now being opened up. There are still extensive areas over which the steam coal is at present entirely untouched. Thus in the Rumney Valley the steam coal is intact from Bargoed southwards, including the whole of the Caerphilly basin, except that it has recently been tapped at Llanbradach; a new deep pit is, however, being sunk at Senghenydd. In the Sirhowy Valley the steam coal is untouched throughout the whole of the area within the Bedwellty Urban District, and southwards as far as Risca. In the Ebbw Valley there is also a large quantity of steam coal untouched, and it is estimated that in both the Abertillery and Abercarn districts there is coal enough to last 100 years at the present rate of working. Lastly, as regards the Afon Llwyd Valley, there is a large quantity of steam coal to be worked in the Abersychan district where there are some 2,000 acres in the Cwmffrwdoer and Cwmnantddu Valleys still practically untouched.

Upon the whole, it may be safely assumed that these valleys will be the scene of extensive coal-mining operations for very many years to come, and that considerable increase of population may be anticipated in many of those areas which are at present of a rural character.

CONDITION OF THE RIVERS IN REGARD TO POLLUTION.

It may be stated generally that these rivers at present constitute the common sewers of the valleys through which they pass. With but very few exceptions, the 20 sanitary districts, or the parts of those districts* which drain naturally towards one or other of these rivers, discharge into them practically the whole of their slop sewage; and, inasmuch as the majority of these districts have more or less completely adopted some form of water carriage for the disposal of excrement, the rivers also receive a vast quantity of excremental sewage. But, in addition to pollution by sewage, these rivers are also subject to serious pollution by waste trade products, and to some extent also by ashes and other refuse tipped upon their banks. In regard both of trade pollution and pollution by ash-tipping it is, however, satisfactory to be able to state that measures have in not a few instances been recently adopted, as a result of the action of the Monmouthshire and Glamorganshire County Councils, to diminish the illegal fouling of streams by these means. The trade pollution consists of liquid refuse from the ordinary trade processes incident to town and villages, such as refuse from slaughter houses, breweries, fellmongers' yards, and gas works. There are, however, in these valleys certain other very important sources of river pollution, the chief of which are connected with the coal-mining and tin-plating industries so extensively carried on there. There are also one or two chemical works, one galvanising works, and several large brick and tile works.

The pollution of the rivers which results from colliery operations is mostly connected with coal-washing, a process sometimes adopted with a view to rendering small coal more saleable, but most frequently with the object of separating the very fine coal from the fine shale with which it is mixed, for the purpose of utilising the former in the manufacture of coke. The employment of water with the latter object is based upon the fact of the coal being lighter than the shale, whence it follows that when the two are floated together down inclined troughs in water kept in lateral agitation, the shale, or "dirt," as it is technically called, sinks to the bottom, and by special arrangement is carried off into one set of hoppers, while the fine coal floats over the end of the troughs and is collected elsewhere in subsidence in tanks. After the subsidence of the fine coal in this wise, however, the waste water still contains a quantity of yet finer coal in suspension, which, if passed with the waste water into the river, not only gives rise to serious pollution of the stream, but involves also considerable waste of coal-dust of a kind suitable for coke-making. At many collieries, therefore, measures of varying efficiency are adopted with the double object of recovering the fine coal in question and of diminishing the polluting quality of the waste water when ultimately discharged into the river. These measures consist, firstly, of using the same water again and again for the washery, whereby more and more coal and shale are extracted from it, and the ultimate amount of water to be dealt with is considerably reduced; and secondly, in providing special subsiding tanks into which this water is finally allowed to stand for some hours before being discharged into the river, the resulting deposit of coal-dust being then

* In some instances practically the whole of the districts. The remaining three of the 23 districts shown on pages 102 and 103, viz., the Cardiff, Newport, and Caerleon Urban Districts, though slightly abutting upon one or other of the rivers in question, contribute but little, or not at all, to the pollution of these rivers, since their populous areas drain naturally either into the Severn or the Usk, and therefore hardly come within the scope of this inquiry.

removed from the tanks for coke-making. In this way a large quantity of coal suitable for coking purposes is recovered from the waste water. At one washery I was informed that 50 tons of usable coal, which would otherwise go into the river, are thus recovered each week. There is obviously great advantage in repeatedly using the same water in the washery. Where this is not done the amount of water continuously running to waste is so large—in the case of one washery visited by me 20,0C0 gallons per hour—that any serious attempt to deal with it by the older method of mere subsidence would involve the provision of enormous tank accommodation, notwithstanding which, serious pollution of the river and waste of coal might result.

Pollution of the rivers by tin-plate and by galvanising works is due to the discharge into them from these businesses of the "waste pickle." This pickle consists of dilute acid, usually sulphuric acid in the case of tin-plate works and hydrochloric acid at galvanising works, in which the iron plates are steeped in preparation for receiving the tin or zinc respectively. The waste pickle contains a considerable quantity of acid, some two-thirds of which, probably, are in combination with iron, and the remaining third free. The usual method of disposing of the waste pickle of tin-plate works, where avoidance of river pollution is aimed at, is by boiling it down in lead-lined tanks and subsequently crystallising out the sulphate of iron, or copperas, which it contains. This process is of course not applicable where hydrochloric acid is used, as in galvanising, and the waste pickle has to be neutralised by passing it over limestone before it is allowed to flow into the river.

From what has been said it will be understood that the rivers in question are in an extremely foul condition, and that they are liable in hot weather to become very offensive, especially in their upper reaches, where in dry seasons they dwindle to insignificant streams. The Rumney, for instance, as it passes the town of Rhymney, is said to contain little, at such times, but sewage, and much the same is said to be the case with regard to the Sirhowy, at Tredegar. Moreover, notwithstanding the measures recently taken with a view to limiting trade pollutions, these rivers are still much discoloured. They are usually, for a considerable part of their course, either almost or quite black, as a consequence mainly of pollution from collieries, or are of a colour varying from greyish yellow to dirty orange, as a result chiefly of pollution from tin-plate and iron works. In these respects there are, of course, some little differences between the several rivers, and also between the several parts of each river considered separately. Judged by their colour, the Afon Llwyd and Ebbw Fach show most indication of chemical pollution of the kinds referred to, while the Ebbw Fawr and Sirhowy afford most evidence of pollution by coal-dust. On the whole the Rumney river exhibits rather less indication of trade pollution than the others, though all are much discoloured. It should, however, be mentioned that the orange discoloration referred to is, no doubt, contributed to by ferruginous springs issuing from the Coal Measures, usually through abandoned colliery workings. Springs of this kind, sometimes of a deep orange colour, may be seen entering the rivers in different localities. Apart from the colour of the water, evidence of trade pollution is also furnished by the coal-dust, and sometimes by glistening particles of metal, which may be seen on the banks of the rivers. In some localities considerable silting up of the river beds by coal and shale dust has occurred, and as a consequence of final subsidence of such débris, the discoloration of the rivers is, in the lower reaches, less marked.

That pollution of the rivers has increased of late years is evident from the fact of the disappearance of fish in localities where they were freely caught some 20 years ago. In the course of my inspections I heard of trout being still occasionally caught in the Rumney as high as Maesycwmmer, and in the Ebbw river within the Risca district about the confluence of the Sirhowy and Ebbw rivers. The systematic use of water from these rivers for drinking purposes, such as that referred to by the late Mr. Netten Radcliffe, who in 1878 described some of the inhabitants of the Tredegar Urban District as having recourse to the stream of the Sirhowy, appears to have been abandoned; and indeed it is difficult, in view of the appearance of this river, to conceive of anyone thinking of drinking water therefrom, though I was informed that school children still occasionally drink water from the Rumney in one locality in the lower part of its course.

The River Rumney.

Pollution by Sewage.—This river is seriously polluted by sewage, most conspicuously so by the districts abutting upon its eastern bank; some attempt has at least been made by the authorities on the west or Glamorganshire side to dispose of their sewage otherwise than by turning it crude into the river. Thus, upon its eastern side the river receives, in the Rhymney Urban District, practically the whole of the "untreated" sewage, which consists mainly of slop sewage (though also of some excremental sewage), brewery refuse, and slaughter-house drainage; in the Bedwellty Urban District, the whole of the sewage (including most of the excrement) of the towns of New Tredegar and Elliot Town, a quantity of slop sewage from Cwmsifiog, and the slop sewage of the villages of Aber Bargoed and Pengam; and in the St. Mellons Rural District, most of the slop sewage of Maesycwmmer, Bedwas, and Machen, as well as the slop sewage from various hamlets and scattered cottages. On its eastern side, therefore, this river receives the slop sewage of a very considerable population, and, in addition, a not inconsiderable quantity of excremental sewage. From the western side it habitually receives some "untreated" sewage from Pontlottyn (Gelligaer Rural District), though most of the sewage from this mining village is treated by irrigation on grass land; occasionally, at all events, it receives sewage (including excrement) from the mining villages of Tyr Phil and Brithdir (Gelligaer Rural District)—for although special arrangements have been made for distributing this sewage over grass land before allowing it to find its way into the river, at the time of my visit practically the whole of the sewage from the former village, and some of that from the latter, was going direct into the river without being so distributed; a considerable quantity of slop sewage from the large village of Bargoed (population, some 2,000, Gelligaer Rural District), though in its course along an overgrown ditch this sewage becomes somewhat clarified; some slop sewage from Llanbradach (Caerphilly Urban District), though, with a view to avoiding pollution of the river, most of the sewage from this new mining village is discharged into large cesspools, pending the carrying out of a complete sewage scheme. In addition to the above, the Rumney receives, on its western side, a certain amount of slop sewage from different hamlets, such as Hengoed and Ystrad Mynach (Gelligaer Rural District), and from scattered dwellings, and as well a large quantity of sewage brought to it by the following tributaries: The Bargoed Rumney, in the Gelligaer Rural District, which brings sewage (including some excrement)

from the village of Fochrhiw (population, 805) in that district; the Aber Brook and the Cledr Brook, both in the Caerphilly Urban District, the former of which conveys to it the sewage of the new and rapidly-growing mining village of Senghenydd, while the latter brings the sewage of the town of Caerphilly.

Trade Pollution.—The Rumney receives a certain amount of pollution from minor trade processes, such as brewing, fellmongering, and slaughtering of cattle, but the most important polluting trade processes are coal-washing and tin-plate working. These processes are not, however, at present, carried out on a large scale in the Rumney Valley; coal-washing appears to be carried out only in two localities, viz., at Brithdir (Gelligaer District), by the Powell Dyffryn Coal Company, and at Llanbradach (Caerphilly District). At Brithdir the washing is accomplished by a modern Belgian "washery," erected at considerable cost. By this method the water employed in the process is used again and again, and is ultimately discharged into a large tank, where the suspended detritus is allowed to settle before the water is discharged into the river. Nothing was being discharged into the river at the time of my visit, and I am therefore unable to speak as to the character of the effluent from this tank. Owing, however, to the character of the plant and the procedure adopted, it would not seem likely that the pollution caused by coal-washing at Brithdir is of a very serious character as compared with what occurs elsewhere. At Llanbradach, on the other hand, the methods adopted are far less satisfactory. The water, which is pumped from the pit, is not used repeatedly, but is passed continuously, to the extent of 20,000 gallons an hour, through the washer, which it leaves, carrying with it a large quantity of coal and shale; it is then rapidly passed through a "settling" tank, measuring 31′ × 3′2″ × 5′, and thence to a watercourse leading to the river. At the time of my visit this tank was practically full of deposit, over which the waste water from the washer was running, the effluent being as black as ink.

The only tin-plate works at present working in the Rumney Valley are the Waterloo Works, at Rudry, in the Llandaff and Dinas Powis Rural District. These works were not actually in operation at the time of my visit. Boiling and settling tanks have, however, been provided, to which, I was informed, all the waste acid from the pickle-tubs is pumped for use in the manufacture of copperas. The effluent from the settling tanks is, it was said, used again and again until it is all evaporated by boiling, or converted into copperas.

At Maesycwmmer, in the St. Mellons Rural District, there are some pyroligneous acid works which drain into a tributary of the River Rumney. At the time of my visit, however, I did not find evidence of any notable pollution from this source.

The River Sirhowy.

Sewage Pollution.—The most serious pollution of the Sirhowy river by sewage is that which occurs in the urban district of Tredegar, where the slop sewage of a population of some 18,000 persons, and a considerable share of their excremental sewage, are poured, without any attempt at purification, into the stream. Lower down, the river also receives, either directly or indirectly through tributary streams, most of the crude slop sewage of the villages of Hollybush, Argoed, and Blackwood, in the Bedwellty Urban District, and some of the slop sewage from various villages and scattered groups of dwellings in the St. Mellons

Rural District, especially Cwmcorrwg, Woodfield, Gelligroes, and Pont Llanfraith, though in this rural district some attempt has been made to limit pollution of the river by the use of cesspools for the disposal of slop sewage.

Trade Pollution.—There are no tin-plate works in this valley, or other works likely to cause serious chemical pollution. Coal-washing is practised at Tytrist and Sirhowy Collieries in the Tredegar Urban District. At the former the Belgian process is in use, at the latter a less efficient method.

THE RIVER EBBW FAWR.

Pollution by Sewage.—Except in the case of certain parts of Beaufort it may be said that practically the whole of the liquid sewage from the urban district of Ebbw Vale, which has a population of some 17,000 persons, is discharged into this river without any attempt at purification, either directly or indirectly by way of brooks or "feeders." Owing to the general adoption of pail or "box" closets in this district, only a comparatively small proportion of the excrement finds its way into the river, which is, however, very seriously polluted by the slop sewage..

Trade Pollution.—Coal-washing is carried on at Nos. 5 and 22 Pits, Ebbw Vale, and the river is considerably polluted thereby. At the time of my visit the effluent had the appearance of ink, and the river below was on each of the several occasions upon which I saw it almost as black.

THE RIVER EBBW FACH.

Pollution by Sewage.—This river is very seriously polluted by sewage, no attempt having as yet been made with a view to the treatment of the sewage of the considerable aggregations of population situated upon its banks or upon the banks of its important tributary, the Cwm Tillery. It receives at its very commencement the sewage of a portion of Beaufort Hill, in the Ebbw Vale Urban District, and that from some 30 houses in the Brynmawr (Brecknockshire), Urban District, which in each instance obtains access to it indirectly by passing through the trade reservoirs at its head. Later it receives practically the whole of the sewage (including excrement) of the Nantyglo and Blaina Urban District (population, 12,000), which is discharged into it by some 20 outfalls. And, finally, it receives practically all the sewage of the Abertillery Urban District (population, 9,000), part of which is discharged into it directly and part indirectly through the Cwm Tillery Brook, which joins the river in the Abertillery District.

Trade Pollution.—This is also of a very serious character. Coal-washing is carried on in the Nantyglo and Blaina District at Stories Pit, and in the Abertillery District at the Cwm Tillery Pit. At the former one tank has been provided, and at the latter, four, with a view to recovering some of the fine coal from the "washery" waste water. In neither case, however, did the result appear to me to be satisfactory, the effluent, which in both instances finds its way indirectly into the Ebbw Fach, being at the time of my visit in each case very black. The river is also seriously polluted by waste acid from the Lion Tin-plate Works, at Nantyglo, from the Blaina Tin-plate Works, at Blaina, and from the Abertillery Tin-plate Works, at none of which works had copperas plant been provided.

The (main) River Ebbw.

This river, after receiving the grossly polluted waters of the Ebbw Fawr and Ebbw Fach, is further seriously polluted on its course of some 13 miles to the Usk estuary. On its way from Aberberg to Crumlin it receives the whole of the "untreated" sewage of the colliery villages of Caesirnoth, a group of some 90 houses, and of Llanhilleth, some 250 houses, in the Abertillery Urban District. Lower down it receives in succession most of the slop sewage of the Abercarn Urban District, either directly or through the Cwm Torlas Brook, a grossly polluted stream; of the Risca Urban District; and of the villages of Rogerstone, Bassaleg, and Pentrepoeth, in the St. Mellons Rural District. At the Pontymister Tin-plate Works, in the Risca District, copperas plant has recently been provided for recovering the waste acid from the pickle-tubs, which formerly constituted the most serious source of trade pollution of this part of the river. Coal-washing is carried out at the Upper Abercarn Pit, but tanks have been provided in which the waste water, after having been repeatedly used, is allowed to stand for 36 hours before being passed into the river.

The River Afon Llwyd.

Sewage Pollution.—This river receives practically the slop sewage, and most of the excrement of the Blaenavon Urban District (population, 11,000); of the Abersychan Urban District (population, 15,000); and of the Pontypool Urban District (population, 6,000). To a less extent it receives sewage from the Panteg Urban District (Cwm Ynys-cow and Pontymoile); from the Llanfrechfa Upper Urban District (Upper Cwmbran); from the Llantarnam Urban District (Forge Hammer Division, and part of the Glencoed Division); from the Pontypool Rural District (part of); and from the Magor Rural and the Caerleon Urban Districts. As regards the Panteg, Llanfrechfa Upper, and Llantarnam Urban Districts, however, arrangements have been made, though of an imperfect character, for dealing with most of the sewage upon land. At the time of my visit most of the sewage at one of the principal outfalls in the Llantarnam District was flowing by way of a ditch to the Cwmbran Brook, a tributary of the Afon Llwyd, instead of overt he land.

Trade Pollution.—Coal-washing is carried on extensively at the Blaenavon Company's Washery, at Blaenavon, at the Varteg Colliery in the Abersychan Urban District, and at the Cwmbran Colliery in the Llanfrechfa Upper Urban District. In all these instances settling tanks have been provided for recovering a portion of the coal-dust from the waste water from the "washeries." The arrangements for limiting the pollution of the river from this cause are least satisfactory at the Cwmbran Colliery, where the waste water from the washery is not used a second time, but is passed continuously away through one of the subsiding tanks. At the time of my visit the tank in use was full of deposit, and the waste water was merely running over its surface, thus undergoing but little, if any, purification. At that date tin-plating was carried on in the Afon Llwyd Valley at the Town Forge at Pontypool; at the Pontrhydyrun Tin-plate Works, at Pontrhydyrun, in the Panteg Urban District; at the Tynewydd Tin-plate Works, and the Avondale Tin-plate Works, both at Pontnewydd, in the Llanfrechfa Upper Urban District; and at the Caerleon Tin-plate Works in the Magor Rural District. There are several other tin-plate works within the valley, as the Osborne Forge Tin-plate Works in the Abersychan Urban District;

the Panteg Tin-plate Works and the Pontymoile Tin-plate Works, both in the Panteg Urban District. These were, however, closed at the time of my visit. In addition to tin-plate works there are some galvanising works near Pontymoile, in the Panteg Urban District, at which sulphuric and hydrochloric acids are used in pickling the plates. At the Pontryhydyrun Works, and at the Avondale Works, the waste acid from the pickle-tubs was being allowed to find its way into the river, from the former directly, from the latter by way of the Upper Cwmbran Brook. At the Pontrhydyrun Works, however, copperas tanks had recently been provided, and would, I was informed, be used for the future. The waste hydrochloric acid from the galvanising works at Pontymoile was, I found, being passed over limestone in a small tank, though but little of the waste liquor was coming into contact with the limestone. At the Tynewydd Works, and the Caerleon Works, copperas tanks had been provided, and at the Pontypool Town Forge the waste pickle is stored in tanks, and, as I was informed, sent away to copperas works elsewhere. The waste water from the swilling tanks is, however, at these works passed directly into the river, and at the Tynewydd Works into the Upper Cwmbran Brook.

General Remarks upon Sewerage and Drainage.

As will appear from the more detailed accounts of the sanitary circumstances of the several urban and rural districts situate in these valleys, which are appended to this Report,* the arrangements in regard to sewerage and drainage are, speaking generally, of a most unsatisfactory character. This is most conspicuously the case in the older towns and villages, many of which still depend mainly upon old stone or brick culverts and box-drains, put down many years ago, usually by the owners of the collieries or ironworks which gave rise to the towns in question. These old "sewers" are for the most part unprovided with proper provision for ventilation and flushing, and although, owing to the topographical features of the districts, they have in many cases steep gradients, the foul character of the sewage issuing from them leaves little doubt that in not a few cases they admit of deposit with resulting decomposition of their contents. Frequently, moreover, they pass under dwellings, and in view of their character and the absence of concrete under the houses, there can be little doubt that in such cases sewer-air finds its way into the dwellings in question. More modern extensions of sewerage and the sewerage of newer aggregations of dwellings have certainly been carried out with glazed socketed pipes, but in many instances even these sewers are very imperfectly ventilated. These newer sewers have, moreover, frequently been put down by property owners, sometimes without proper supervision by the local authority, and in some cases the work has certainly been very badly done. Thus, in one instance I met with a pipe sewer, recently put down on an important estate, the pipes of which were for a considerable distance so superficially laid that their crowns were visible above the ground, and they were in several instances broken. The fall was irregular, and the house drains, which were taken into this sewer at right angles, had been connected by the simple process of knocking a hole in the sewer. It is not, of course, suggested that this is a fair sample of the modern sewer in these districts, some of which are apparently well constructed, and I have only quoted it as indicating the need for adequate supervision of the laying of sewers by property owners, a need which I found had in other instances been ignored.

* Not here reproduced.

Like the sewerage, the house drainage is also in very many localities of a faulty and unsuitable character. Old box-drains, defective open channels for slop waters, and untrapped yard sinks are still far from uncommon. And although the large majority of such sinks are trapped, this is most frequently accomplished by that objectionable form of trap, the iron "lip-trap," instead of by a proper self-cleansing gulley. These lip-traps are objectionable both on the score of their acting as receptacles for decomposing filth, as small cesspools in fact, and also for the reason that they are mostly so imperfectly fixed that they may be easily removed, as in practice they frequently are.

Excrement and Refuse Disposal.

In regard to the larger towns and mining villages, the mode of excrement disposal which has most commonly been adopted for newer dwellings, and in substitution for the old cesspit privies of old dwellings (in so far as such substitution has been brought about), is a form of water-carriage consisting of pan-and-siphon closets, sometimes of the "long" and sometimes of the "short" hopper pattern. Such closets are, however, almost invariably unprovided with any water supply, and are thus dependent for cleansing upon hand-flushing, with a result that is often far from satisfactory. These pan-and-siphon closets are, however, a vast improvement upon the cesspit privies, and if the selection of suitably-shaped short hopper pans were more generally encouraged, and the closets provided with proper flushing cisterns, the system would leave little to be desired. As will be seen later, however, the want of a more plentiful water supply stands in the way of the adoption of flushing cisterns in not a few of the districts.

But in certain districts, where the kind of water-carriage above referred to has been adopted, the pan closets are not invariably provided with siphon traps—of course a most serious omission. Then, in the Blaenavon Urban District, a number of iron pan closets directly connected with the drains were met with. In other districts concrete hopper closets, also untrapped, were found; closets which, in addition to being directly connected with the drain, become almost of necessity coated in their interior with excremental filth. In the Ebbw Vale Urban District "dry-ash closets" have been extensively introduced in supersession of privies. These ash closets, which are scavenged by the Urban District Council's contractor, consist of iron boxes, and are mostly provided with arrangements for sifting cinders; a provision which the Council have, however, recently ceased to require. In not a few instances the iron boxes were found to be missing, with the result that the portion of the closet in which the box originally stood had come to be used as a fixed receptacle for excrement, a function it was not constructed to serve.

A varying number of old cesspit privies still exist in most of the older towns, and are in common use in many of the smaller villages and more rural parts of the district. The cleansing of these privies is mostly left to occupiers. But though in some of the country villages the houses are provided with large gardens, wherein the privy contents may be utilised, this is by no means invariably the case. Owing to their construction, position, or want of proper cleansing, many of the old privies are productive of serious nuisance. In some rural localities the substitution of pail closets for old privies has been more or less extensively brought about; a substitution which is, as a rule, especially where supplemented

by arrangements for scavenging the pails, attended with manifest advantage.

As regards the disposal of ashes and house refuse, this is very properly undertaken by the district councils, usually under contract, in most of the larger centres of population, a daily removal of such refuse being arranged for in many of the towns. In the smaller villages open iron ashbins are in many cases provided at certain points by the district councils, who also undertake or contract for the removal of refuse therefrom; such ashbins are, however, for the most part provided in insufficient numbers, and owing to this cause, or to the absence of any suitable accommodation of the kind, ashes and house refuse may be seen lying about in the vicinity of dwellings and in public places. Such matters are often, moreover, when circumstances are favourable, thrown into the rivers or tributary streams.

WATER SUPPLY.

The urban districts of Tredegar, Ebbw Vale, Nantyglo and Blaina, and Abertillery are now, it would appear, sufficiently provided with water from mountain springs and gathering grounds. As a general rule, however, the water supplies of the towns and villages in the several valleys appear to be unsatisfactory, especially as regards quantity.

CONSIDERATIONS IN REGARD TO THE PREVENTION OF THE POLLUTION OF THE RIVERS.

From the facts I have recorded it will have become evident that the pollution by sewage of the rivers in question is of a most serious character; and it can hardly be doubted, as regards the western rivers at all events, *i.e.*, the Ebbw, Sirhowy, and Rumney, that this pollution, unless adequate measures are taken with regard to the purification of sewage, will steadily increase with the increase of population which must inevitably accompany the development of the coal industry in the several valleys concerned. The need for action in the matter appeared to me indeed to be fully recognised by not a few of the local authorities, several of whom have already schemes under consideration for dealing with the sewage of their respective districts. Thus the Caerphilly Urban District Council have prepared a scheme of main sewerage for their district and are awaiting the confirmation by Parliament of a Provisional Order which has been granted them by the Board for the compulsory purchase of land for the purposes of sewage disposal; the urban district councils of Abercarn and Risca have also a joint scheme under consideration for the sewerage of their districts to one outfall below Risca, where it is proposed to deal with the sewage on land. The question of a joint scheme of sewerage and sewage disposal for the Abersychan, Pontypool, and Panteg Urban Districts has also been under consideration, though the matter appeared at the time of my visit to be at a standstill. I was, further, assured by representatives of some of the other district councils that they quite admitted the need for action in this matter. I regret, however, to say there is apparently still a strong disinclination on the part of the councils of certain urban districts situate at the heads of the valleys, districts which are especially in need of improved sewerage, and are among the most serious offenders as regards river pollution, to adopt any suitable measures of sewerage and of sewage disposal.

But, granted the need for action in the matter, a need which I think would be admitted by any independent person who visited the valleys under consideration, the question arises as to the best means of remedying the existing unsatisfactory state of affairs. Two possible courses suggest themselves.

1. The execution of works of main sewerage and of sewage disposal by the various district councils, each acting independently of the others, or, in particular cases, as dictated by topographical and other circumstances, by two or more districts combining in a joint scheme or schemes.

2. Joint schemes of larger character, comprising main-trunk sewers extending throughout the whole length of the several valleys. A scheme of this latter character has been already suggested by the Monmouth County Surveyor, who proposed to carry main-trunk sewers down the Sirhowy, Ebbw Fawr, Ebbw Fach, and Afon Llwyd Valleys to a common outfall sewer commencing at Bassaleg and discharging into the Severn estuary at low-water mark, near Peterstone. The Rumney Valley might in such case be dealt with in a similar manner, either independently or by junction with the main outfall sewer in question.

With respect to all or any such schemes, it will be evident that, as regards the cleansing of the rivers, success will be dependent upon the adoption of sewage purification by all of the numerous districts naturally draining towards them. And this is practically admitted locally, since the authorities of districts situate in the lower part of the valleys have already on various occasions in correspondence with the Board ascribed their disinclination to undertake sewerage works to the unsatisfactory results which would follow the purification of the sewage of certain districts if no steps were taken with regard to the purification of that of others.

But not only is the adoption of measures of sewage purification by all the district councils concerned essential to success, but the measures must be equally adequate, not only as regards original conception and execution, but as regards subsequent management. Now, the multiplication of outfall works would almost certainly result in considerable diversity of efficiency, especially as regards their practical working in the future.

In regard to the feasibility of cleansing these rivers of sewage by the independent action of individual districts, however, a more serious difficulty arises. The valleys are in many places steep and narrow, and, although there is a certain amount of alluvial meadow land irregularly distributed alongside their streams, this varies considerably, both in amount and as regards suitability of soil, in different localities. Some of the districts, indeed, as the Pontypool, Abersychan, Abercarn, and Risca Urban Districts, appear to possess no suitable land within their own areas to which their sewage could be conveyed by gravitation for the purposes of purification; and to these may, I think, be added the Abertillery Urban District. I am not, however, prepared to say that sufficient land might not be found in these valleys for disposal of sewage on the principle of independent action by the various authorities concerned, if judicious grouping together of districts for sewerage purposes superseded this principle when local circumstances demanded such grouping; though this is, of course, a matter which could only be definitely decided by a detailed engineering survey of the valleys. Such a method of dealing with the matter would, however, in any case involve a multiplicity of outfall works; sometimes, in all probability, two or more such works for the disposa of the sewage of a single district. And even under these circumstances many of the numerous

hamlets and scattered dwellings would be left unprovided for in this respect. Moreover if designed mainly with a view to dealing with the sewage of existing towns and villages, this plan would be likely to fail in making provision for the needs of those portions of the valleys which, although at present sparsely populated, seem, owing to their richness in steam coal, to be destined in the future to become important centres of industry. Independent action would not, therefore, give promise of permanent remedy against pollution of the rivers by sewage. The extreme rapidity with which large colliery villages may spring up in the neighbourhood of new deep pits is now being illustrated at Llanbradach and Senghenydd, in the Caerphilly Urban District, and unless some provision for sewage disposal is made in advance it is in a high degree probable that some of the aggregations of population which will rapidly appear in the vicinity of future pit sinkings may, owing to physical circumstances, find it difficult to dispose of their sewage otherwise than by turning it into the river.

An adequate system of main-trunk sewers for the several valleys would, on the other hand, be free from all the above objections. By providing at once for the conveyance of all sewage to the Severn estuary from existing and future centres of population it would completely and permanently cleanse the rivers of sewage. In the course of my visits to the different districts I found that such a scheme was regarded by many persons as the proper solution of the difficulty, though various objections to it were raised by others. The chief grounds of objection brought to my notice were expense; the possibility of some better method of sewage disposal than now exists being discovered in the near future which might obviate the need for so large an expenditure; the probable disorganisation from time to time of the system by fracture of the main sewers owing to subsidence from undermining; and the likelihood of nuisance being caused to the inhabitants of Newport, Cardiff, and Penarth by the discharge of so large a volume of sewage into the Severn estuary. Objections of this sort appear, indeed, to have formed the grounds upon which the Monmouthshire County Council abstained from urging the adoption of their County Surveyor's scheme.

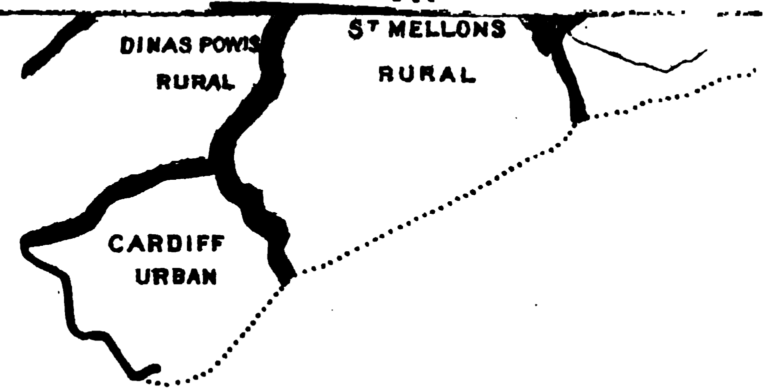
In regard to expense, the Monmouthshire County Surveyor estimates the cost of a system of main-trunk sewers for the valleys of the Sirhowy, Ebbw Fawr, Ebbw Fach, and Afon Llwyd at 200,000*l.*, which, if borrowed at 3½ per cent. repayable in 30 years would, he calculates, entail, for repayment of principal and payment of interest, a 6*d.* rate upon the valleys in question, or if repayable in 50 years a rate of 4½*d.* It may well be doubted whether the construction of a series of main sewers and multiple outfall works for the various districts concerned, including the purchase of land for sewage disposal purposes, would not involve an even larger expenditure, especially in view of the probable perpetual cost in connexion with the disposal of sewage. For it has to be remembered that the question is not as to the absolute, but as to the relative, cost of the two systems. It would probably not be very unsafe to hazard a similar reply to the objection which is based upon possible future developments in the economics of sewage disposal, for there would seem no reasonable prospect of such developments removing the need for main sewers to convey the sewage to one outfall in each district for treatment. And such sewers do not at present exist. Moreover, this argument as to the future possibilities of discovery might, of course, be urged against all progress. The objection with respect to possible fracture of main-trunk sewers is a more reasonable one, and one doubtless requiring the careful consideration of

engineers. Up to the present time there would not appear to have been much subsidence from undermining along the lines of these rivers, except in one or two of the districts where the coal has been most extensively worked. Evidence of actual sinking of the bed of the river, indeed, I met with in only one district, that of Nantyglo and Blaina. In that locality there has been considerable subsidence, as a consequence of which the course of the river became so diverted as to partially submerge a tennis ground. And there can be little doubt that in time to come, when the steam coal has been extensively worked, subsidences will occur lower down the river. Such may not occur on any important scale for many years to come, and owing to the great depth of the coal seams in the basin of these coalfields it will doubtless be of a more general nature, and thus of a less troublesome character than the frequently recurring subsidences over small areas when the mining operations are carried on nearer the surface. In certain localities, where the beds of the rivers are crossed by "faults" in the Coal Measures—such as the Glyn fault, at Newbridge, which crosses the bed of the Ebbw, the Llanfabon fault, which crosses the Rumney, north of Llanbradach, and the fault which crosses the Sirhowy at Gelligroes—it is, of course, likely that subsidences will be sharply defined as the coal will almost certainly be worked out on one side of the "fault" before the other. This is, of course, a matter to be taken into consideration, and it is a question, of course, for engineers as to how the not improbable inconvenience from future sinkings of the kind in question can be overcome by engineering contrivance. It must be remembered, however, that possible inconvenience of the kind in question must not be regarded as exclusively appertaining to main-tunnel sewers. It is, indeed, a possible inconvenience that would have to be faced in connexion with a system of independent main sewers for the several districts concerned. The question has but little bearing in regard to the Afon Llwyd, since south of the Blaenavon Urban District that river lies, for most of its course, outside the eastern limits of the coalfield.

With regard to the likelihood of nuisance resulting from the discharge of sewage into the Severn estuary, this would appear a somewhat remote possibility having regard to the enormous dilution the sewage would undergo. In this connexion I may mention that from inquiries I made it would not appear that any nuisance of the kind has been experienced from the Rhondda Valley outfall. If necessary, however, some "treatment" of the sewage at the outfall prior to its discharge into the Severn might be adopted, though this would, of course, add to the cost of the scheme.

In regard to the question of main-trunk sewers, it should, perhaps, be mentioned that in some of the districts at the head of the valleys, notably the Nantyglo and Blaina Urban District, the river has been culverted in certain localities and covered by railway sidings and slag heaps. It would not appear, however, that this need give rise to serious engineering difficulties, as the main sewer could be carried along the bed of the river beneath the culverts in question.

DIAGRAM A.



Scale: 4 miles to one inch.

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Nos. 13 and 13(a).

COMPILATION of RETURNS of NOTIFIED CASES of CERTAIN INFECTIOUS DISEASES, and REGISTERED DEATHS therefrom.

APP. A. No. 13.

Compilation of Returns of Notified Infectious Diseases and registered Deaths therefrom.

1895.

It should be noted, with reference to these returns, that some of the districts to which they apply administer compulsory notification under local Acts; and that not only are some of the diseases named in the Infectious Disease (Notification) Act of 1889 not notifiable under some of the local Acts, but that under some of these Acts no payment is made for the notification of multiple attacks of the same disease occurring in the same house within a specified date of the first attack notified.

The Urban Districts finding place in these returns in which compulsory notification has been adopted under local Acts are—

Accrington.
Ashton-under-Lyne.
Birkenhead.
Blackburn.
Bolton.
Burnley.
Bury.
Croydon.
Darwen.
Derby.
Halifax.
Hartlepool.
Huddersfield.
Leicester.
Manchester.
Newcastle-on-Tyne.
Norwich.
Nottingham.
Oldham.
Preston.
Reading.
Rotherham.
Stockton-on-Tees.
Sunderland.
Swansea.
Wakefield.
Warrington.
West Ham.
Wigan.
Willesden.
York.

Compilation of Returns of Notified Infectious Diseases, and registered Deaths therefrom.

No. 13.

TABLE showing Quarter by Quarter, during the Year 1895, for each of REGISTERED DEATHS from the under-mentioned DISEASES, together SANITARY DISTRICTS in question.

[The Cases are a Summary of the Weekly Returns of Notifiable Diseases received Quarterly Returns o

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	SMALL-POX.									
			1st Quarter.		2nd Quarter.		3rd Quarter.		4th Quarter.		Total for 1895.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
I.	London (*Administrative Co.*)	4,232,118	142	10	111	3	609	31	122	11	984	55
II. South-Eastern.	Croydon	102,695	—	—	—	—	—	—	—	—	—	—
	Dover	33,300	—	—	—	—	—	—	—	—	—	—
	Eastbourne	34,969	—	—	—	—	13	2	5	—	18	2
	Bournemouth	37,781	—	—	—	—	—	—	—	—	—	—
	Southampton	65,325	—	—	1	—	3	—	2	—	6	—
	Reading	60,054	—	—	—	—	1	—	—	—	1	—
III. South Midland.	Willesden	61,265	2	—	1	—	—	—	1	—	4	—
	Hornsey	44,205	—	—	—	—	1	—	—	—	1	—
	Tottenham	71,343	—	—	—	—	3	—	—	—	3	—
	Oxford	45,742	—	—	—	—	—	—	4	—	4	—
	Northampton	61,012	—	—	—	—	—	—	—	—	—	—
	Cambridge	36,983	—	—	—	—	—	—	1	—	1	—
	Leyton	63,056	—	—	—	—	8	—	—	—	8	—
IV. Eastern	Walthamstow	46,346	—	—	—	—	1	—	—	—	1	—
	West Ham	204,903	17	—	—	—	17	—	93	10	127	10
	Colchester	34,559	—	—	—	—	—	—	—	—	—	—
	Norwich	100,970	—	—	—	—	—	—	—	—	—	—
V. South-Western.	Exeter	37,404	—	—	—	—	—	—	3	—	3	—
	Plymouth	84,248	—	—	1	—	—	—	—	—	1	—
	Devonport	54,803	—	—	—	—	—	—	—	—	—	—
	Bath	51,844	—	—	—	—	—	—	—	—	—	—
VI. West Midland.	Bristol	221,578	—	—	—	—	—	—	2	—	2	—
	St. George	36,718	—	—	—	—	—	—	—	—	—	—
	Gloucester	39,444	—	—	1	—	4	—	21	3	26	3
	Burton-on-Trent	46,047	—	—	1	—	—	—	—	—	1	—
	Wolverhampton	82,662	3	—	4	—	—	—	—	—	7	—
	Walsall	71,789	—	—	—	—	1	—	—	—	1	—
	West Bromwich	59,474	7	—	1	—	—	—	—	—	8	—
	Worcester	42,908	—	—	—	—	1	—	—	—	1	—
	Smethwick	36,170	5	—	1	—	—	—	1	—	7	—
	Birmingham	478,113	102	7	3	1	—	—	—	—	105	8
	Aston Manor	68,639	31	4	3	—	1	—	—	—	35	4
	Coventry	52,724	—	—	—	—	—	—	—	—	—	—
VII. North Midland.	Leicester	174,624	3	—	1	—	—	—	—	—	4	—
	Grimsby	51,934	—	—	—	—	—	—	—	—	—	—
	Nottingham	213,877	—	—	3	—	—	—	—	—	3	—
	Derby	94,146	19	4	59	4	8	—	—	—	86	8

No. 13.

81 URBAN SANITARY DISTRICTS, the Number of NOTIFIED CASES and of with an ANNUAL SUMMARY of these data for each of the URBAN

by the Board from Medical Officers of Health. The Deaths are extracted from the the Registrar-General.]

APP. A. No. 13.

Compilation of Returns of Notified Infectious Diseases, and registered Deaths therefrom.

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	SMALL-POX—*continued.* 1st Quarter. Cases.	1st Quarter. Deaths.	2nd Quarter. Cases.	2nd Quarter. Deaths.	3rd Quarter. Cases.	3rd Quarter. Deaths.	4th Quarter. Cases.	4th Quarter. Deaths.	Total for 1895. Cases.	Total for 1895. Deaths.
VIII. North-Western.	Stockport - -	70,263	—	—	—	—	—	—	2	—	2	—
	Macclesfield - -	36,000	—	—	—	—	—	—	—	—	—	—
	Birkenhead - -	99,857	1	—	1	—	1	—	—	—	3	—
	Liverpool - -	517,980	90	8	23	3	4	2	5	—	122	13
	St. Helens (Lancs.) -	71,288	—	—	9	—	—	—	—	—	9	—
	Southport - -	41,406	—	—	1	—	—	—	—	—	1	—
	Wigan - - -	55,013	—	—	12	1	40	2	36	5	88	8
	Warrington - -	52,743	—	—	—	—	—	—	—	—	—	—
	Bolton - - -	115,002	—	—	10	1	—	—	—	—	10	1
	Bury (Lancs.) - -	57,212	—	—	—	—	—	—	—	—	—	—
	Salford - - -	198,139	—	—	2	—	3	—	—	—	5	—
	Manchester - -	505,368	—	—	12	—	35	2	5	—	52	2
	Ashton-under-Lyne -	40,463	—	—	2	—	—	—	—	—	2	—
	Oldham - - -	131,463	—	—	32	3	91	17	14	2	137	22
	Accrington - -	38,603	—	—	—	—	—	—	—	—	—	—
	Burnley - - -	87,016	8	—	—	—	7	—	—	—	15	—
	Blackburn - -	120,064	—	—	—	—	—	—	—	—	—	—
	Darwen - - -	34,192	—	—	—	—	—	—	—	—	—	—
	Preston - - -	107,573	—	—	—	—	—	1	—	—	—	1
	Barrow-in-Furness -	51,712	—	—	—	—	—	—	—	—	—	—
IX. Yorkshire.	Huddersfield - -	95,420	—	—	—	—	—	—	—	—	—	—
	Halifax - - -	89,832	—	—	—	—	—	—	—	—	—	—
	Bradford - -	216,361	—	—	—	—	—	—	—	—	—	—
	Leeds - - -	367,505	8	—	1	—	—	—	—	—	9	—
	Wakefield - - -	33,146	—	—	—	—	—	—	—	—	—	—
	Barnsley - -	35,427	—	—	—	—	3	—	—	—	3	—
	Sheffield - -	324,243	—	—	1	—	—	—	—	—	1	—
	Rotherham - -	42,061	—	—	—	—	—	—	—	—	—	—
	York - - -	67,004	—	—	—	—	—	—	—	—	—	—
	Hull - - -	200,044	—	—	—	—	3	—	1	—	4	—
	Middlesbrough - -	75,532	1	—	—	—	1	—	—	—	2	—
X. Northern.	Darlington - -	38,060	—	—	—	—	—	—	—	—	—	—
	Stockton-on-Tees -	49,705	—	—	—	—	—	—	—	—	—	—
	West Hartlepool -	42,710	—	—	—	—	1	—	—	—	1	—
	Sunderland - -	131,015	—	—	1	—	—	—	—	—	1	—
	South Shields - -	78,391	—	—	20	1	—	—	1	—	21	1
	Newcastle-on-Tyne -	186,300	—	—	—	—	—	—	1	—	1	—
	Tynemouth - -	46,588	—	—	—	—	1	—	—	—	1	—
	Carlisle - - -	39,176	1	—	—	—	—	—	—	—	1	—
XI. Welsh.	Newport (Mon.) -	54,707	1	—	—	—	—	—	7	—	8	—
	Cardiff - - -	128,915	—	—	—	—	—	—	1	—	1	—
	Merthyr Tydfil - -	58,080	—	—	—	—	—	—	1	—	1	—
	Swansea - -	90,349	—	—	—	—	—	—	—	—	—	—
	Totals, 81 Districts -	12,257,700	441	33	318	17	861	57	329	31	1,949	138

APP. A. No. 13.

Compilation of Returns of Notified Infectious Diseases, and registered Deaths therefrom.

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	Scarlet Fever.									
			1st Quarter.		2nd Quarter.		3rd Quarter.		4th Quarter.		Total for 1895.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
I.	London - - (*Admin. Co.*)	4,232,118	2,962	141	3,438	166	6,080	253	7,284	269	19,773	829
II. South-Eastern.	Croydon - -	102,695	26	2	30	—	33	2	61	—	150	4
	Dover - -	33,300	8	—	2	—	10	1	21	—	41	1
	Eastbourne -	34,969	28	—	9	—	7	—	18	—	62	—
	Bournemouth -	37,781	14	1	13	—	15	2	54	1	96	4
	Southampton -	65,325	17	—	63	6	96	7	172	2	348	15
	Reading - -	60,054	73	2	78	4	81	—	94	3	326	9
III. South Midland.	Willesden -	61,265	36	—	90	2	140	9	128	5	394	16
	Hornsey -	44,205	295	1	47	3	33	2	46	—	421	6
	Tottenham -	71,343	41	—	37	2	82	3	107	3	267	8
	Oxford - -	45,742	22	—	45	—	67	—	63	—	197	—
	Northampton -	61,012	59	1	47	2	88	1	66	2	260	6
	Cambridge -	36,983	20	—	9	—	9	—	17	—	55	—
	Leyton - -	63,056	105	1	77	2	145	2	288	7	615	12
IV. Eastern.	Walthamstow -	46,346	30	—	56	2	89	3	100	2	275	7
	West Ham -	204,903	153	5	218	8	438	13	594	19	1,403	45
	Colchester -	34,559	37	—	47	2	10	1	16	1	110	4
	Norwich -	100,970	79	2	52	3	96	5	54	—	281	10
V. South-Western.	Exeter - -	37,404	27	2	10	—	19	—	31	1	87	3
	Plymouth -	84,248	10	—	13	—	18	—	31	2	72	2
	Devonport -	54,803	13	1	6	—	23	—	20	—	62	1
	Bath - -	51,844	4	—	13	—	15	—	37	1	69	1
VI. West Midland.	Bristol - -	221,578	50	1	67	—	131	4	318	11	566	16
	St. George -	36,718	14	2	13	—	23	—	70	3	120	5
	Gloucester -	39,444	23	1	11	—	12	—	19	1	65	2
	Burton-on-Trent	46,047	36	1	27	—	105	1	152	3	320	5
	Wolverhampton	82,662	196	16	95	2	165	8	157	7	613	33
	Walsall - -	71,789	21	—	26	1	33	—	22	1	102	2
	West Bromwich	59,474	30	1	38	1	37	8	48	6	153	16
	Worcester -	42,908	21	—	22	1	55	—	44	—	142	1
	Smethwick -	36,170	36	—	41	1	60	2	81	1	218	4
	Birmingham -	478,113	372	9	519	16	1001	39	1083	63	2,975	127
	Aston Manor -	68,639	19	2	24	—	136	1	220	5	399	8
	Coventry -	52,724	100	2	116	5	133	7	95	4	444	18
VII. North Midland.	Leicester -	174,624	111	2	162	6	203	4	286	4	762	16
	Grimsby -	51,934	62	2	24	—	26	1	32	—	144	3
	Nottingham -	213,877	325	18	247	12	309	9	343	12	1,224	51
	Derby - -	94,146	106	3	83	2	61	1	117	2	367	8

App. A. No. 13.

Compilation of Returns of Notified Infectious Diseases, and registered Deaths therefrom.

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	Scarlet Fever—*continued.*									
			1st Quarter.		2nd Quarter.		3rd Quarter.		4th Quarter.		Total for 1895.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
VIII. North-Western.	Stockport - -	70,263	19	—	29	1	30	1	88	—	166	2
	Macclesfield -	36,000	1	—	12	—	8	—	12	—	33	—
	Birkenhead -	99,857	138	3	55	3	97	3	143	7	433	16
	Liverpool - -	517,980	609	35	496	23	559	43	727	43	2,391	144
	St. Helens (Lancs.)	71,288	38	2	56	3	40	3	88	1	222	9
	Southport - -	41,406	93	4	21	2	36	—	37	5	187	11
	Wigan - -	55,013	44	3	39	—	44	—	26	2	153	5
	Warrington -	52,743	58	7	32	—	53	1	90	8	233	16
	Bolton - -	115,002	31	6	41	2	130	4	304	11	506	23
	Bury (Lancs.) -	57,212	41	1	31	5	30	—	53	1	155	7
	Salford - -	198,139	278	35	230	15	264	20	380	27	1,152	97
	Manchester -	505,368	415	46	404	19	708	47	709	57	2,296	169
	Ashton-under-Lyne	40,463	23	2	48	3	85	4	87	6	243	15
	Oldham - -	131,463	26	2	40	1	86	3	65	9	217	15
	Accrington - -	38,603	43	2	30	3	56	3	33	1	162	9
	Burnley - -	87,016	206	8	98	6	92	4	55	4	451	22
	Blackburn - -	120,064	45	—	66	2	65	—	53	6	229	8
	Darwen - -	34,192	9	—	11	1	10	—	14	1	44	2
	Preston - -	107,573	18	—	21	3	18	—	30	1	87	4
	Barrow-in-Furness	51,712	32	1	14	—	25	—	49	—	120	1
IX. Yorkshire.	Huddersfield -	95,420	104	6	132	5	149	6	155	2	540	19
	Halifax - -	89,832	9	—	9	1	26	3	11	1	55	5
	Bradford - -	216,361	119	7	75	5	96	3	89	10	379	25
	Leeds - -	367,505	149	7	116	5	303	18	310	21	878	51
	Wakefield - -	33,146	5	—	8	—	99	—	147	—	259	—
	Barnsley - -	35,427	87	2	68	8	73	3	51	4	279	17
	Sheffield - -	324,243	207	9	114	9	181	5	264	10	766	33
	Rotherham - -	42,061	67	3	36	3	25	5	48	2	176	13
	York - -	67,004	31	3	25	—	29	—	56	1	141	4
	Hull - - -	200,044	158	8	175	9	319	7	421	15	1,073	39
	Middlesbrough -	75,532	83	4	149	5	321	14	456	12	1,009	35
X. Northern.	Darlington - -	38,060	9	—	4	—	19	—	31	1	63	1
	Stockton-on-Tees -	49,705	145	10	116	7	267	9	199	5	727	31
	West Hartlepool -	42,710	15	—	35	5	69	5	64	5	183	15
	Sunderland -	131,015	131	3	93	3	102	3	127	2	453	11
	South Shields -	78,391	135	9	61	4	66	1	119	2	381	16
	Newcastle-on-Tyne	186,300	131	3	96	3	257	4	468	12	952	22
	Tynemouth - -	46,588	56	2	28	3	77	2	91	10	252	17
	Carlisle - -	39,176	17	2	4	—	22	—	21	1	64	3
XI. Welsh.	Newport (Mon.) -	54,707	18	—	32	—	21	—	38	1	109	1
	Cardiff - -	128,915	112	1	85	2	126	—	163	5	486	8
	Merthyr Tydfil -	58,080	25	—	21	—	67	—	67	—	180	—
	Swansea - -	90,349	113	3	56	1	39	—	69	1	277	5
	Totals, 81 Districts	12,257,700	9,674	458	9,227	419	15,282	613	18,957	754	53,140	2,244

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	Diphtheria.									
			1st Quarter.		2nd Quarter.		3rd Quarter.		4th Quarter.		Total for 1895.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
I.	London - - (*Admin. Co.*)	4,232,118	1,733	426	2,141	446	3,126	602	3,777	842	10,777	2,316
II. South-Eastern.	Croydon -	102,695	47	7	21	7	25	—	38	7	131	21
	Dover - -	33,300	—	—	2	—	—	1	6	2	8	3
	Eastbourne -	34,969	9	—	6	—	14	1	5	1	34	2
	Bournemouth -	37,781	3	—	1	—	10	1	14	4	28	5
	Southampton -	65,325	7	—	7	—	9	1	9	2	32	3
	Reading -	60,054	8	—	8	1	2	1	5	1	23	3
III. South Midland.	Willesden -	61,265	19	—	26	5	63	14	70	17	178	36
	Hornsey -	44,205	19	—	13	4	27	10	30	10	89	24
	Tottenham -	71,343	40	—	16	3	46	6	70	13	172	22
	Oxford - -	45,742	44	—	9	1	4	—	17	4	74	5
	Northampton -	61,012	3	—	4	1	2	3	5	1	14	5
	Cambridge -	36,983	9	—	5	2	5	1	6	1	25	4
	Leyton - -	63,056	55	—	100	29	143	17	113	13	411	59
IV. Eastern.	Walthamstow -	46,346	52	—	38	7	40	6	72	12	202	25
	West Ham -	204,903	157	34	171	46	262	53	270	59	860	192
	Colchester -	34,559	12	—	20	1	6	—	2	—	40	1
	Norwich -	100,970	15	3	6	4	14	7	43	5	78	19
V. South-Western.	Exeter - -	37,404	7	—	4	—	6	—	3	6	20	6
	Plymouth -	84,248	7	1	8	3	6	—	12	—	33	4
	Devonport -	54,803	5	—	3	1	2	—	8	4	18	5
	Bath - -	51,844	5	—	11	2	15	3	16	5	47	10
VI. West Midland.	Bristol - -	221,578	35	11	28	3	42	9	50	11	155	34
	St. George -	36,718	2	—	3	2	6	3	15	—	26	5
	Gloucester -	39,444	5	—	5	—	4	2	9	1	23	3
	Burton-on-Trent	46,047	7	—	38	5	32	6	19	8	96	19
	Wolverhampton	82,662	34	20	80	24	56	14	139	26	309	84
	Walsall - -	71,789	5	—	2	1	4	3	3	1	14	5
	West Bromwich	59,474	4	—	4	3	—	3	6	2	14	8
	Worcester -	42,908	4	—	6	4	11	2	5	2	26	8
	Smethwick -	36,170	1	—	9	1	—	—	1	—	11	1
	Birmingham -	478,113	120	48	124	42	161	31	240	62	645	183
	Aston Manor -	68,639	18	—	13	4	14	4	59	20	104	28
	Coventry -	52,724	—	—	1	—	—	—	4	3	5	3
VII. North Midland.	Leicester -	174,624	19	10	8	6	20	7	23	12	70	35
	Grimsby - -	51,934	15	1	21	7	8	2	26	6	70	16
	Nottingham -	213,877	14	3	7	1	15	4	11	2	47	10
	Derby - -	94,146	22	2	8		6	1	12	1	48	6

App. A. No. 13.

Compilation of Returns of Notified Infectious Diseases, and registered Deaths therefrom.

Registration Divisions.	Urban Sanitary Districts.	Population (1891).	Diphtheria—*continued.* 1st Quarter. Cases.	1st Quarter. Deaths.	2nd Quarter. Cases.	2nd Quarter. Deaths.	3rd Quarter. Cases.	3rd Quarter. Deaths.	4th Quarter. Cases.	4th Quarter. Deaths.	Total for 1895. Cases.	Total for 1895. Deaths.
VIII. North-Western.	Stockport - -	70,263	3	2	7	3	8	4	17	13	35	22
	Macclesfield -	36,000	1	1	4	3	43	11	67	16	115	31
	Birkenhead -	99,857	30	10	26	8	18	8	62	19	136	45
	Liverpool - -	517,980	50	29	43	27	45	29	93	35	231	120
	St. Helens (Lancs.)	71,288	17	2	18	1	14	3	11	1	60	7
	Southport - -	41,406	7	3	2	—	4	—	3	—	16	3
	Wigan - -	55,013	3	1	3	1	2	1	5	1	13	4
	Warrington -	52,743	7	2	2	1	—	—	6	2	15	5
	Bolton - -	115,002	10	5	7	3	7	5	9	3	33	16
	Bury (Lancs.) -	57,212	5	5	5	1	9	4	12	13	31	23
	Salford - -	198,139	55	13	34	8	36	17	49	24	174	62
	Manchester -	505,368	92	27	87	28	69	11	82	42	330	108
	Ashton-under-Lyne	40,463	1	2	2	4	1	1	4	4	8	11
	Oldham - -	131,463	21	10	13	5	13	5	21	6	68	26
	Accrington - -	38,603	9	2	3	—	4	1	16	1	32	4
	Burnley - -	87,016	18	7	21	8	29	15	38	10	106	43
	Blackburn - -	120,064	13	6	4	1	3	—	3	2	23	9
	Darwen - -	34,192	2	—	—	—	—	—	—	2	2	2
	Preston - -	107,573	5	2	3	2	—	—	7	4	15	8
	Barrow-in-Furness	51,712	10	8	6	2	7	2	6	2	29	14
IX. Yorkshire.	Huddersfield -	59,420	6	2	8	4	8	4	12	5	34	15
	Halifax - -	89,832	11	2	5	3	8	4	9	5	33	14
	Bradford - -	216,361	10	4	7	6	11	5	9	5	37	20
	Leeds - -	367,505	41	24	14	14	30	14	46	13	131	65
	Wakefield - -	33,146	4	—	2	—	10	—	9	—	25	—
	Barnsley - -	35,427	10	2	6	4	5	3	8	2	29	11
	Sheffield - -	324,243	26	21	16	7	23	12	25	12	90	52
	Rotherham -	42,061	7	1	1	—	4	1	2	—	14	2
	York - -	67,004	3	—	1	—	16	3	13	4	33	7
	Hull - - -	200,044	28	8	30	11	18	8	29	10	105	37
	Middlesbrough -	75,532	5	1	1	—	4	3	12	5	22	9
X. Northern.	Darlington - -	38,060	4	3	6	1	8	5	5	3	23	12
	Stockton-on-Tees -	49,705	5	4	7	2	3	2	13	3	28	11
	West Hartlepool -	42,710	4	3	10	6	3	2	—	1	17	12
	Sunderland -	131,015	11	5	3	2	4	—	7	1	25	8
	South Shields -	78,391	7	3	6	2	7	3	7	5	27	13
	Newcastle-on-Tyne	186,300	27	7	20	4	47	12	83	29	177	52
	Tynemouth -	46,588	6	1	3	1	4	—	8	2	21	4
	Carlisle - -	39,176	17	—	3	—	12	2	10	4	42	6
XI. Welsh.	Newport (Mon.) -	54,707	2	3	4	4	3	2	6	—	15	9
	Cardiff - -	128,915	56	12	62	18	50	14	61	12	229	56
	Merthyr Tydfil -	58,080	11	4	7	4	7	2	8	1	33	11
	Swansea - -	90,349	13	3	9	3	8	4	4	2	34	12
	Totals, 81 Districts	12,257,700	3,234	816	3,498	870	4,811	1,043	6,110	1,490	17,653	4,219

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	"FEVER." 1st Quarter. Notifications. Typhus.	Enteric.	Continued.	Total.	Deaths.	2nd Quarter. Notifications. Typhus.	Enteric.	Continued.	Total.	Deaths.
I.	London (*Administrative County*)	4,232,118	4	674	20	698	135	5	590	27	622	81
II. South-Eastern.	Croydon	102,695	—	15	—	15	7	—	5	—	5	1
	Dover	33,300	—	3	—	3	2	—	—	—	—	—
	Eastbourne	34,969	—	4	—	4	—	—	1	—	1	—
	Bournemouth	37,781	—	1	—	1	—	—	3	—	3	1
	Southampton	65,325	—	4	—	4	—	—	13	—	13	2
	Reading	60,054	—	5	—	5	—	—	5	—	5	2
III. South Midland.	Willesden	61,265	—	16	—	16	2	—	3	—	3	—
	Hornsey	44,205	—	9	—	9	2	—	3	1	4	1
	Tottenham	71,343	—	13	1	14	1	—	15	1	16	3
	Oxford	45,742	—	3	—	3	—	—	—	—	—	—
	Northampton	61,012	—	4	—	4	3	—	7	—	7	1
	Cambridge	36,983	—	7	—	7	2	—	8	—	8	2
	Leyton	63,056	—	15	2	17	2	—	12	3	15	4
IV. Eastern.	Walthamstow	46,346	—	13	—	13	—	—	5	—	5	1
	West Ham	204,903	—	47	—	47	16	1	31	—	32	8
	Colchester	34,559	—	9	2	11	—	—	1	1	2	—
	Norwich	100,970	—	21	—	21	5	—	24	—	24	5
V. South-Western.	Exeter	37,404	—	10	—	10	1	—	14	—	14	3
	Plymouth	84,248	—	2	—	2	—	—	8	—	8	3
	Devonport	54,803	—	3	1	4	2	—	7	—	7	2
	Bath	51,844	—	4	—	4	2	—	1	—	1	—
VI. West Midland.	Bristol	221,578	—	28	—	28	8	—	16	—	16	2
	St. George	36,718	—	—	—	—	—	—	1	—	1	—
	Gloucester	39,444	—	6	1	7	3	—	1	—	1	1
	Burton-on-Trent	46,047	—	12	—	12	1	—	11	—	11	3
	Wolverhampton	82,662	—	16	—	16	8	—	14	1	15	—
	Walsall	71,789	—	27	2	29	4	—	14	—	14	2
	West Bromwich	59,474	—	15	—	15	2	—	12	—	12	1
	Worcester	42,908	—	4	—	4	2	—	5	1	6	—
	Smethwick	36,170	1	2	—	3	2	—	9	—	9	1
	Birmingham	478,113	—	113	1	114	20	—	81	—	81	15
	Aston Manor	68,639	—	3	—	3	—	—	4	—	4	1
	Coventry	52,724	—	4	—	4	1	—	11	1	12	—
VII. North Midland.	Leicester	174,624	—	30	—	30	6	—	49	—	49	5
	Grimsby	51,934	—	7	3	10	3	—	10	1	11	3
	Nottingham	213,877	—	64	—	64	9	—	51	—	51	11
	Derby	94,146	—	21	—	21	4	—	15	—	15	2

"Fever."															
3rd Quarter.					4th Quarter.					Totals for 1895.					Urban Sanitary Districts.
Notifications.					Notifications.					Notifications.					
Typhus.	Enteric.	Continued.	Total.	Deaths.	Typhus.	Enteric.	Continued.	Total.	Deaths.	Typhus.	Enteric.	Continued.	Grand Total.	Deaths.	
2	868	27	897	159	4	1,381	31	1,416	254	15	3,513	105	3,633	629	London. (*Admin. Co.*)
—	8	2	10	3	—	16	2	18	3	—	44	4	48	14	Croydon.
—	1	—	1	—	—	9	—	9	—	—	13	—	13	2	Dover.
—	8	—	8	1	—	5	—	5	—	—	18	—	18	1	Eastbourne.
—	4	—	4	3	—	1	—	1	1	—	9	—	9	5	Bournemouth.
—	28	—	28	5	—	16	—	16	3	—	61	—	61	10	Southampton.
—	14	—	14	1	—	11	—	11	1	—	35	—	35	4	Reading.
—	10	—	10	3	—	41	—	41	8	—	70	—	70	13	Willesden.
—	7	—	7	1	—	25	1	26	1	—	44	2	46	5	Hornsey.
1	24	—	25	5	—	42	—	42	3	1	94	2	97	12	Tottenham.
—	6	—	6	1	—	6	—	6	1	—	15	—	15	2	Oxford.
—	12	—	12	4	—	16	—	16	—	—	39	—	39	8	Northampton.
—	3	—	3	—	—	10	—	10	1	—	28	—	28	5	Cambridge.
—	30	4	34	3	—	35	5	40	1	—	92	14	106	10	Leyton.
—	40	—	40	4	—	32	6	38	6	—	90	6	96	11	Walthamstow.
—	109	—	109	16	—	133	2	135	25	1	320	2	323	65	West Ham.
—	3	—	3	—	—	5	2	7	2	—	18	5	23	2	Colchester.
—	78	—	78	4	—	102	—	102	12	—	225	—	225	26	Norwich.
—	4	2	6	1	—	9	1	10	4	—	37	3	40	9	Exeter.
—	9	—	9	1	—	9	—	9	3	—	28	—	28	7	Plymouth.
—	15	—	15	4	—	15	—	15	4	—	40	1	41	12	Devonport.
—	2	—	2	—	—	4	—	4	—	—	11	—	11	2	Bath.
—	20	—	20	7	—	27	1	28	4	—	91	1	92	21	Bristol.
—	4	—	4	—	—	4	—	4	—	—	9	—	9	—	St. George.
—	5	—	5	2	—	6	—	6	4	—	18	1	19	10	Gloucester.
—	16	—	16	2	—	47	—	47	3	—	86	—	86	9	Burton-on-Trent.
—	33	7	40	4	—	63	—	63	10	—	126	8	134	17	Wolverhampton.
—	17	—	17	1	—	11	1	12	3	—	69	3	72	10	Walsall.
—	42	—	42	4	—	63	1	64	10	—	132	1	133	17	West Bromwich.
—	7	—	7	1	—	1	—	1	—	—	17	1	18	3	Worcester.
—	10	—	10	—	—	6	—	6	—	1	27	—	28	3	Smethwick.
—	95	2	97	24	—	149	1	150	22	—	438	4	442	81	Birmingham.
—	19	—	19	4	—	15	—	15	1	—	41	—	41	6	Aston Manor.
—	26	4	30	3	—	9	3	12	2	—	50	8	58	6	Coventry.
—	76	—	76	8	—	110	—	110	20	—	265	—	265	39	Leicester.
—	101	3	104	9	—	63	7	70	10	—	181	14	195	25	Grimsby.
—	125	—	125	11	—	193	—	193	23	—	433	—	483	54	Nottingham.
—	22	—	22	6	—	39	—	39	6	—	97	—	97	18	Derby.

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	"Fever." 1st Quarter. Notifications. Typhus.	Enteric.	Continued.	Total.	Deaths.	2nd Quarter. Notifications. Typhus.	Enteric.	Continued.	Total.	Deaths.
VIII. North-Western.	Stockport	70,263	—	6	—	6	—	—	7	1	8	—
	Macclesfield	36,000	—	1	—	1	1	—	3	—	3	—
	Birkenhead	99,857	—	30	—	30	10	2	40	—	42	7
	Liverpool	517 980	59	197	16	272	38	22	350	17	389	51
	St. Helens (Lancs.)	71,288	—	28	1	29	12	—	20	—	20	3
	Southport	41,406	—	5	—	5	2	—	3	—	3	1
	Wigan	55,013	2	9	4	15	—	3	10	7	20	2
	Warrington	52,743	1	15	—	16	6	—	3	1	4	—
	Bolton	115,002	—	49	1	50	15	—	14	—	14	2
	Bury (Lancs.)	57,212	—	28	—	28	1	—	10	1	11	4
	Salford	198,139	—	46	1	47	16	—	76	2	78	19
	Manchester	505,368	—	117	—	117	29	—	93	—	93	17
	Ashton-under-Lyne	40,463	—	6	1	7	1	—	9	2	11	1
	Oldham	131,463	—	15	—	15	3	—	18	—	18	5
	Accrington	38,603	—	8	—	8	1	—	5	—	5	1
	Burnley	87,016	—	25	—	15	6	—	17	—	17	3
	Blackburn	120,064	—	28	—	28	8	—	19	—	19	6
	Darwen	34,192	—	3	—	3	1	—	12	—	12	2
	Preston	107,573	—	18	—	18	2	—	17	—	17	2
	Barrow-in-Furness	51,712	—	8	4	12	3	—	4	3	7	1
IX. Yorkshire.	Huddersfield	95,420	—	1	—	1	—	—	13	—	13	3
	Halifax	89,832	—	11	2	13	5	—	11	—	11	2
	Bradford	216,361	—	19	—	19	6	—		—	18	4
	Leeds	367,505	—	16	1	17	6	—	34	2	36	6
	Wakefield	33,146	—	8	—	8	—	—	10	—	10	—
	Barnsley	35,427	—	6	—	6	1	—	5	—	5	2
	Sheffield	324,243	—	48	2	50	11	—	40	3	43	11
	Rotherham	42,061	—	5	—	5	1	—	15	—	15	3
	York	67,004	—	5	2	7	2	—	8	5	13	1
	Hull	200,044	1	40	4	45	7	—	35	1	36	7
	Middlesbrough	75,532	—	45	2	47	4	—	29	—	29	3
X. Northern.	Darlington	38,060	—	13	—	13	1	—	2	—	2	—
	Stockton-on-Tees	49,705	—	21	—	21	4	—	7	2	9	2
	West Hartlepool	42,710	—	7	—	7	—	—	4	1	5	1
	Sunderland	131,015	1	78	17	96	12	—	46	3	49	12
	South Shields	78,391	—	13	1	14	4	—	25	1	26	7
	Newcastle-on-Tyne	186,300	—	82	7	89	19	—	40	8	48	10
	Tynemouth	46,588	—	9	—	9	1	—	12	—	12	1
	Carlisle	39,176	—	7	—	7	—	—	—	—	—	—
XI. Welsh.	Newport (Mon.)	54,707	—	6	1	7	2	—	2	—	2	—
	Cardiff	128,915	—	18	1	19	3	—	8	1	9	2
	Merthyr Tydfil	58,080	—	49	—	49	6	—	30	—	30	3
	Swansea	90,349	—	20	—	20	4	—	19	—	19	5
	Totals, 81 Districts	12,257,700	69	2,393	101	2,563	504	33	2,203	98	2,334	379

"FEVER."															
3rd Quarter.					4th Quarter.					Totals for 1895.					Urban Sanitary Districts.
Notifications.					Notifications.					Notifications.					
Typhus.	Enteric.	Continued.	Total.	Deaths.	Typhus.	Enteric.	Continued.	Total.	Deaths.	Typhus.	Enteric.	Continued.	Grand Total.	Deaths.	
—	17	—	17	3	—	42	1	43	16	—	72	2	74	19	Stockport.
—	22	1	23	2	—	2	—	2	1	—	28	1	29	4	Macclesfield.
—	41	—	41	5	—	76	—	76	20	2	187	—	189	42	Birkenhead.
24	309	16	349	49	55	313	21	389	49	160	1,169	70	1,399	187	Liverpool.
—	95	1	96	19	—	117	—	117	26	—	260	2	262	60	St. Helens (Lancs.).
—	18	—	18	2	—	23	—	23	4	—	49	—	49	9	Southport.
2	14	14	30	2	14	35	8	57	5	21	68	33	122	9	Wigan.
—	10	—	10	3	—	14	—	14	5	1	42	1	44	14	Warrington.
—	71	—	71	15	—	111	—	111	21	—	245	1	246	53	Bolton.
—	10	2	12	3	—	20	3	23	5	—	68	6	74	13	Bury (Lancs.).
—	108	7	115	14	—	160	2	162	39	—	390	12	402	88	Salford.
—	89	—	89	15	—	206	—	206	38	—	505	—	505	99	Manchester.
—	8	5	13	1	—	15	11	26	7	—	38	19	57	10	Ashton-under-Lyne.
—	25	—	25	2	—	50	—	50	16	—	108	—	108	26	Oldham.
—	35	—	35	5	—	31	—	31	7	—	79	—	79	14	Accrington.
—	28	—	28	7	—	46	—	46	14	—	116	—	116	30	Burnley.
—	20	—	20	8	—	51	—	51	7	—	118	—	118	29	Blackburn.
—	5	—	5	3	—	15	1	16	2	—	35	1	36	8	Darwen.
—	49	—	49	7	—	47	—	47	11	—	131	—	131	22	Preston.
—	2	6	8	1	—	8	3	11	4	—	22	16	38	9	Barrow-in-Furness.
—	19	—	19	2	—	27	—	27	1	—	60	—	60	6	Huddersfield.
—	14	1	15	3	—	23	—	23	6	—	59	3	62	16	Halifax.
—	48	—	48	7	—	92	—	92	23	—	177	—	177	40	Bradford.
—	127	5	132	20	—	238	16	254	50	—	415	24	439	82	Leeds.
—	8	—	8	—	—	22	—	22	—	—	48	—	48	—	Wakefield.
—	32	—	32	8	—	81	—	81	12	—	124	—	124	23	Barnsley.
—	148	5	153	24	—	244	2	246	51	—	480	12	492	97	Sheffield.
—	23	—	23	3	—	30	—	30	5	—	73	—	73	12	Rotherham.
—	85	5	90	11	—	70	—	70	8	—	168	12	180	22	York.
—	111	10	121	11	—	101	13	114	23	1	287	28	316	48	Hull.
—	75	2	77	7	—	87	1	88	14	—	236	5	241	28	Middlesbrough.
—	33	3	36	8	—	20	1	21	4	—	68	4	72	13	Darlington.
1	49	3	53	6	—	109	9	118	9	1	186	14	201	21	Stockton-on-Tees.
—	23	1	24	5	—	25	1	26	6	—	59	3	62	12	West Hartlepool.
—	489	26	515	55	—	258	43	301	53	1	871	89	961	132	Sunderland.
—	46	8	54	9	—	68	14	82	11	—	152	24	176	31	South Shields.
—	31	7	38	5	—	68	15	83	14	—	221	37	258	48	Newcastle-on-Tyne.
—	27	—	27	1	—	20	—	20	2	—	68	—	68	5	Tynemouth.
—	4	—	4	—	—	9	—	9	2	—	20	—	20	2	Carlisle.
—	10	—	10	2	1	6	—	7	2	1	24	1	26	6	Newport (Mon.)
—	28	1	29	5	—	26	2	28	5	—	80	5	85	15	Cardiff.
—	71	—	71	8	—	66	2	68	5	—	216	2	218	22	Merthyr Tydfil.
—	74	—	74	6	—	47	—	47	5	—	160	—	160	20	Swansea.
30	4,452	180	4,662	677	74	5,848	233	6,155	1,059	206	14,906	612	15,724	2,619	Totals, 81 Districts.

No. 13 (*a*).

TABLE showing, Week by Week, during the Year 1895, for each of the SANITARY AREAS within the CASES of and REGISTERED DEATHS from the following DISEASES, together with

[The Cases are copied from the Weekly Returns of Notifiable Diseases received by the Board from the Metropolitan

	Sanitary Areas.	Population (1891).	SMALL-POX. Weekly Statement, 1st Quarter, 1895. Jan. 5. Cases.	Jan. 5. Deaths.	Jan. 12. Cases.	Jan. 12. Deaths.	Jan. 19. Cases.	Jan. 19. Deaths.	Jan. 26. Cases.	Jan. 26. Deaths.	Feb. 2. Cases.	Feb. 2. Deaths.	Feb. 9. Cases.	Feb. 9. Deaths.
	London	4,232,118	[a]3	—	13	—	12	1	7	—	26	2	12	3
	(*Administrative County*)		[b]*3*	—	*11*	—	*10*	—	*7*	—	*26*	—	*11*	—
W. District.	Kensington	166,308	—	—	—	—	—	—	—	—	—	—	—	—
	Fulham	91,639	—	—	—	—	—	—	—	—	—	—	—	—
	Hammersmith	97,239	—	—	—	—	—	—	—	—	—	—	—	—
	Paddington	117,846	—	—	—	—	—	—	—	—	—	—	—	—
	Chelsea	96,253	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Hanover Sq.*	78,599	—	—	—	—	—	—	—	—	—	—	—	—
	Westminster	55,539	—	—	—	—	—	—	—	—	—	—	—	—
	St. James, Westminster	24,995	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	1	—	6	—	9	1	4	—	25	2	9	3
	Hampstead	68,416	—	—	—	—	—	—	—	—	—	—	—	—
	St. Pancras	234,379	1	—	—	—	—	—	—	—	—	—	—	—
	Islington	319,143	—	—	—	—	—	—	—	—	—	—	—	—
	St. Mary, Stoke Newington	30,936	—	—	—	—	—	—	—	—	—	—	—	—
	Hackney	198,606	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	—	—
	St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	—	—	—	—	—	—
	Strand†	25,217	—	—	—	—	—	—	—	—	—	—	—	—
	Holborn‡	34,043	—	—	—	—	—	—	1	—	—	—	1	—
	Clerkenwell	66,216	—	—	—	—	—	—	—	—	—	—	—	—
	St. Luke, Middlesex	42,440	—	—	—	—	—	—	—	—	—	—	—	—
	London, City of §	37,583	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Shoreditch	124,009	—	—	—	—	—	—	—	—	—	—	—	—
	Bethnal Green	129,132	—	—	—	—	—	—	—	—	—	—	—	—
	Whitechapel‖	74,420	—	—	—	—	—	—	—	—	—	—	—	—
	St. George-in-the-East	45,795	—	—	—	—	—	—	—	—	—	—	—	—
	Limehouse	57,376	—	—	—	—	—	—	—	—	—	—	—	—
	Mile End Old Town	107,592	—	—	—	—	—	—	—	—	—	—	1	—
	Poplar	166,748	1	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. Saviour, Southwark	27,177	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Southwark	59,712	—	—	—	—	—	—	—	—	—	—	—	—
	Newington	115,804	—	—	—	—	—	—	—	—	—	—	—	—
	St. Olave, Southwark	12,723	—	—	—	—	—	—	—	—	—	—	—	—
	Bermondsey	84,682	—	—	—	—	—	—	—	—	—	—	—	—
	Rotherhithe	39,255	—	—	1	—	—	—	—	—	—	—	—	—
	Lambeth	275,203	—	—	—	—	—	—	—	—	—	—	—	—
	Battersea	150,558	—	—	5	—	2	—	—	—	—	—	—	—
	Wandsworth	156,942	—	—	—	—	—	—	—	—	—	—	—	—
	Camberwell	235,344	—	—	—	—	—	—	—	—	1	—	—	—
	Greenwich	165,413	—	—	1	—	1	—	1	—	—	—	1	—
	Lewisham	92,647	—	—	—	—	—	—	—	—	—	—	—	—
	Woolwich	40,848	—	—	—	—	—	—	—	—	—	—	—	—
	Plumstead	52,436	—	—	—	—	—	—	—	—	—	—	—	—
	Lee	36,103	—	—	—	—	—	—	—	—	—	—	—	—
	Port of London	—	—	—	—	—	—	—	1	—	—	—	—	—

[a] Totals of actual *notifications*.
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

No. 13 (*a*.).

ADMINISTRATIVE COUNTY of LONDON and for the COUNTY as a WHOLE, the NUMBER of NOTIFIED
QUARTERLY and ANNUAL SUMMARIES of these Data for each of the AREAS in question.
Asylums Board. The Deaths are extracted from the Weekly Returns compiled by the Registrar-General.]

SMALL-POX—*continued.*

Weekly Statement, 1st Quarter, 1895—*continued.*														Totals for 1st Quarter, 1895.		Sanitary Areas.
Feb. 16.		Feb. 23.		March 2.		March 9.		March 16.		March 23.		March 30.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
8	1	21	1	11	1	9	—	11	1	16	—	10	—	159	10	London.
8	—	*21*	—	*8*	—	*8*	—	*10*	—	*15*	—	*8*	—	*142*	—	(*Administrative County.*)
—	—	—	—	1	—	1	—	—	—	—	—	—	—	2	—	Kensington.
—	—	—	—	—	—	1	—	—	—	—	—	—	—	1	—	Fulham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hammersmith.
1	—	—	—	—	—	—	—	—	—	1	—	2	—	4	—	Paddington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Chelsea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. James, Westminster.
6	1	17	1	3	—	3	—	2	1	5	—	—	—	90	9	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hampstead.
1	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	St. Pancras.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Islington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Mary, Stoke Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hackney.
—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Strand.†
—	—	1	—	4	—	—	—	3	—	—	—	2	—	12	—	Holborn.‡
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	London, City of.§
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Shoreditch.
—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	Bethnal Green.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Whitechapel.‖
—	—	—	—	1	—	—	—	—	—	—	—	—	—	1	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Limehouse.
—	—	1	—	—	—	—	—	—	—	—	—	—	—	2	—	Mile End Old Town.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	St. George, Southwark.
—	—	1	—	—	1	—	—	—	—	—	—	—	—	1	1	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	Bermondsey.
—	—	—	—	—	—	—	—	3	—	4	—	4	—	12	—	Rotherhithe.
—	—	—	—	1	—	—	—	—	—	—	—	1	—	2	—	Lambeth.
—	—	—	—	—	—	2	—	—	—	—	—	—	—	9	—	Battersea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Wandsworth.
—	—	1	—	—	—	—	—	—	—	1	—	—	—	3	—	Camberwell.
—	—	—	—	1	—	2	—	1	—	4	—	—	—	12	—	Greenwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Woolwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

District	Sanitary Areas.	Population (1891).	April 6. Cases.	April 6. Deaths.	April 13. Cases.	April 13. Deaths.	April 20. Cases.	April 20. Deaths.	April 27. Cases.	April 27. Deaths.	May 4. Cases.	May 4. Deaths.	May 11. Cases.	May 11. Deaths.
			Small-pox—*continued.* Weekly Statement, 2nd Quarter, 1895.											
	London	4,232,118	[a]9	—	9	—	7	—	18	—	12	1	5	—
	(*Administrative County*)	-	[b]*8*	—	*9*	—	*6*	—	*14*	—	*11*	—	*5*	—
W. District.	Kensington	166,308	—	—	—	—	—	—	—	—	—	—	1	—
W. District.	Fulham	91,639	—	—	—	—	—	—	—	—	—	—	—	—
W. District.	Hammersmith	97,239	—	—	—	—	—	—	—	—	1	—	1	—
W. District.	Paddington	117,846	2	—	—	—	—	—	1	—	—	—	—	—
W. District.	Chelsea	96,253	—	—	—	—	—	—	—	—	—	—	—	—
W. District.	St. George, Hanover Sq.*	78,599	—	—	—	—	—	—	—	—	—	—	—	—
W. District.	Westminster	55,539	—	—	—	—	—	—	—	—	—	—	—	—
W. District.	St. James, Westminster	24,995	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	1	—	—	—	1	—	—	—	—	—	—	—
N. District.	Hampstead	68,416	—*	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Pancras	234,379	—	—	2	—	—	—	—	—	—	—	—	—
N. District.	Islington	319,143	2	—	1	—	—	—	—	—	1	—	1	—
N. District.	St. Mary, Stoke Newington	30,936	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	Hackney	198,606	—	—	—	—	—	—	—	—	—	—	1	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	Strand†	25,217	—	—	—	—	—	—	1	—	—	—	—	—
Central District.	Holborn‡	34,043	1	—	—	—	3	—	9	—	2	—	—	—
Central District.	Clerkenwell	66,216	—	—	—	—	—	—	—	—	—	—	1	—
Central District.	St. Luke, Middlesex	42,440	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	London, City of§	37,583	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Shoreditch	124,009	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Bethnal Green	129,132	—	—	—	—	—	—	—	—	2	—	—	—
E. District.	Whitechapel‖	74,420	—	—	—	—	1	—	—	—	—	—	—	—
E. District.	St. George-in-the-East	45,795	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Limehouse	57,376	—	—	1	—	—	—	—	—	—	—	—	—
E. District.	Mile End Old Town	107,592	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Poplar	166,748	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. Saviour, Southwark	27,177	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. George, Southwark	59,712	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Newington	115,804	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. Olave, Southwark	12,723	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Bermondsey	84,682	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Rotherhithe	39,255	—	—	4	—	—	—	4	—	2	1	—	—
S. District.	Lambeth	275,203	2	—	1	—	2	—	2	—	—	—	—	—
S. District.	Battersea	150,558	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Wandsworth	156,942	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Camberwell	235,344	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Greenwich	165,413	1	—	—	—	—	—	1	—	—	—	—	—
S. District.	Lewisham	92,647	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Woolwich	40,848	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Plumstead	52,436	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Lee	36,103	—	—	—	—	—	—	—	—	4	—	—	—
S. District.	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications.*
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

SMALL-POX—*continued.*

Weekly Statement, 2nd Quarter, 1895—*continued.*														Totals for 2nd Quarter, 1895.		Sanitary Areas.
May 18.		May 25.		June 1.		June 8.		June 15.		June 22.		June 29.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
7	—	8	—	2	—	5	—	7	1	8	—	27	1	124	3	London.
7	—	*7*	—	*1*	—	*5*	—	*6*	—	*8*	—	*24*	—	*111*	—	(*Administrative County.*)
1	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	Kensington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Fulham.
—	—	—	—	—	—	1	—	—	1	—	—	—	—	3	1	Hammersmith.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	Paddington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Chelsea.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	1	—	—	—	2	—	3	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. James, Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hampstead.
—	—	—	—	—	—	—	—	2	—	—	—	—	—	4	—	St. Pancras.
—	—	—	—	—	—	—	—	1	—	—	—	—	—	6	—	Islington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Mary, Stoke Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Hackney.
—	—	—	—	—	—	—	—	—	—	1	—	—	1	1	1	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	2	—	3	—	Strand.†
—	—	—	—	—	—	—	—	—	—	—	—	1	—	16	—	Holborn.‡
1	—	—	—	—	—	—	—	—	—	1	—	—	—	3	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	London, City of.§
—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	Shoreditch.
—	—	—	—	—	—	—	—	1	—	—	—	—	—	3	—	Bethnal Green.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Whitechapel.‖
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Limehouse.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Mile End Old Town.
—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	1	—	1	—	2	—	St. George, Southwark.
—	—	—	—	—	—	—	—	1	—	1	—	1	—	3	—	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	3	—	3	—	Bermondsey.
4	—	—	—	—	—	—	—	—	—	—	—	1	—	15	1	Rotherhithe.
1	—	7	—	2	—	2	—	—	—	1	—	2	—	22	—	Lambeth.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Battersea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Wandsworth.
—	—	—	—	—	—	—	—	1	—	2	—	9	—	12	—	Camberwell.
—	—	1	—	—	—	2	—	—	—	—	—	—	—	5	—	Greenwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	Woolwich.
—	—	—	—	—	—	—	—	—	—	—	—	2	—	2	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

Sanitary Areas.		Population (1891).	Small-pox—*continued.* Weekly Statement, 3rd Quarter, 1895. July 6. Cases.	July 6. Deaths.	July 13. Cases.	July 13. Deaths.	July 20. Cases.	July 20. Deaths.	July 27. Cases.	July 27. Deaths.	Aug. 3. Cases.	Aug. 3. Deaths.	Aug. 10. Cases.	Aug. 10. Deaths.
London		4,232,118	[a]14	3	39	1	22	—	106	1	100	1	59	3
(*Administrative County*)		-	[b]*13*	—	*37*	—	*20*	—	*98*	—	*90*	—	*54*	—
W. District.	Kensington	166,308	—	—	—	—	2	—	—	—	1	—	—	—
	Fulham	91,639	—	—	—	—	—	—	—	—	—	—	—	—
	Hammersmith	97,239	—	—	—	—	—	—	—	—	1	—	—	—
	Paddington	117,846	—	—	—	—	1	—	—	—	—	—	3	—
	Chelsea	96,253	—	—	1	—	—	—	—	—	2	—	2	—
	St. George, Hanover Sq.*	78,599	—	—	—	—	—	—	—	—	—	—	—	—
	Westminster	55,539	—	—	1	—	—	—	—	—	2	—	—	—
	St. James, Westminster	24,995	—	—	1	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	1	—	3	—	1	—	7	—	2	—	—	—
	Hampstead	68,416	—	—	—	—	—	—	—	—	2	—	—	—
	St. Pancras	234,379	—	—	2	—	—	—	1	1	2	—	—	—
	Islington	319,143	1	—	1	—	—	—	2	—	2	—	—	—
	St. Mary, Stoke Newington	30,936	—	—	—	—	—	—	—	—	—	—	—	—
	Hackney	198,606	1	—	—	—	—	—	6	—	—	—	1	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	2	—	2	—	—	—	4	—	1	—	1	—
	St. Martin-in-the-Fields	14,616	—	—	1	—	—	—	—	—	2	—	—	—
	Strand†	25,217	—	1	1	—	—	—	1	—	—	1	—	—
	Holborn‡	34,043	1	—	2	—	2	—	—	—	—	—	3	—
	Clerkenwell	66,216	—	—	1	—	—	—	—	—	1	—	2	—
	St. Luke, Middlesex	42,440	—	—	—	—	—	—	—	—	2	—	—	—
	London, City of §	37,583	—	—	—	—	2	—	1	—	1	—	—	—
E. District.	Shoreditch	124,009	—	—	—	—	—	—	3	—	—	—	2	1
	Bethnal Green	129,132	—	—	—	—	—	—	6	—	17	—	5	—
	Whitechapel‖	74,420	—	—	2	—	5	—	43	—	13	—	10	2
	St. George-in-the-East	45,795	—	—	—	—	—	—	4	—	2	—	7	—
	Limehouse	57,376	—	—	2	—	1	—	—	—	5	—	—	—
	Mile End Old Town	107,592	—	—	—	—	—	—	6	—	20	—	2	—
	Poplar	166,748	—	—	—	—	—	—	1	—	4	—	—	—
S. District.	St. Saviour, Southwark	27,177	—	—	—	—	—	—	—	—	—	—	1	—
	St. George, Southwark	59,712	2	—	8	—	8	—	8	—	6	—	3	—
	Newington	115,804	1	—	2	—	—	—	4	—	—	—	3	—
	St. Olave, Southwark	12,723	—	—	1	—	—	—	—	—	—	—	—	—
	Bermondsey	84,682	—	—	1	—	—	—	—	—	—	—	—	—
	Rotherhithe	39,255	—	—	—	—	—	—	—	—	2	—	—	—
	Lambeth	275,203	1	—	2	—	—	—	6	—	1	—	5	—
	Battersea	150,558	—	—	1	—	—	—	—	—	2	—	1	—
	Wandsworth	156,942	—	—	—	—	—	—	—	—	—	—	2	—
	Camberwell	235,344	4	2	4	1	—	—	3	—	5	—	4	—
	Greenwich	165,413	—	—	—	—	—	—	—	—	—	—	—	—
	Lewisham	92,647	—	—	—	—	—	—	—	—	1	—	—	—
	Woolwich	40,848	—	—	—	—	—	—	—	—	—	—	—	—
	Plumstead	52,436	—	—	—	—	—	—	—	—	1	—	2	—
	Lee	36,103	—	—	—	—	—	—	—	—	—	—	—	—
	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications.*
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235).; † Including Middle Temple (population, 95).

SMALL-POX—*continued.*

Weekly Statement, 3rd Quarter, 1895—*continued.*														Totals for 3rd Quarter, 1895.		Sanitary Areas.
Aug. 17.		Aug. 24.		Aug. 31.		Sept. 7.		Sept. 14.		Sept. 21.		Sept. 28.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
92	1	69	6	37	4	39	5	40	2	21	2	23	2	661	31	London.
81	—	*62*	—	*37*	—	*36*	—	*38*	—	*21*	—	*22*	—	*609*	—	(*Administrative County.*)
—	—	1	—	1	—	—	—	—	—	1	—	—	—	6	—	Kensington.
—	—	—	—	—	—	1	—	—	—	—	—	—	—	1	—	Fulham.
—	—	1	—	—	—	—	—	—	—	—	—	1	—	3	—	Hammersmith.
—	—	—	—	—	—	—	—	1	—	—	—	—	—	5	—	Paddington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	—	Chelsea.
1	—	—	—	—	—	—	—	1	1	—	—	1	—	3	1	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	St. James, Westminster.
1	—	3	—	—	—	—	—	—	—	—	—	1	—	19	—	St. Marylebone.
2	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	Hampstead.
2	—	—	—	1	—	1	—	—	—	—	—	—	—	9	1	St. Pancras.
—	—	1	—	2	—	4	1	1	—	4	—	—	—	18	1	Islington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Mary, Stoke Newington.
1	—	1	—	1	—	2	—	2	—	—	—	1	1	16	1	Hackney.
2	—	—	1	—	—	—	—	—	—	—	—	—	—	12	1	St. Giles and St. George, Bloomsbury.
—	1	—	—	—	—	—	—	—	—	—	—	—	—	3	1	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	2	Strand.†
—	—	2	—	2	—	—	—	—	—	—	—	—	—	12	—	Holborn.‡
4	—	—	—	1	—	—	—	—	—	—	—	—	—	9	—	Clerkenwell.
—	—	1	—	—	—	—	—	—	—	—	—	—	—	3	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	1	—	—	—	—	—	5	—	London, City of.§
4	—	2	—	—	—	1	—	—	—	3	1	—	—	15	2	Shoreditch.
13	—	21	1	3	1	5	—	12	—	2	—	6	—	90	2	Bethnal Green.
11	—	8	—	2	1	4	1	5	—	1	—	1	—	105	4	Whitechapel.‖
3	—	1	—	—	—	—	—	1	—	1	—	—	—	19	—	St. George-in-the-East.
3	—	—	—	1	—	1	—	1	—	—	—	2	—	16	—	Limehouse.
6	—	5	—	8	1	1	—	1	—	—	—	—	—	49	1	Mile End Old Town.
3	—	4	—	1	1	2	—	—	—	1	—	1	—	17	1	Poplar.
—	—	2	—	—	—	—	—	—	—	—	—	—	—	3	—	St. Saviour, Southwark.
7	—	2	—	—	—	—	—	—	—	—	—	—	—	44	—	St. George, Southwark.
2	—	—	1	—	—	—	—	—	—	—	—	—	—	12	1	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	St. Olave, Southwark.
2	—	—	—	—	—	1	—	—	—	—	—	—	—	4	—	Bermondsey.
12	—	2	—	—	—	—	—	—	—	—	—	—	—	16	—	Rotherhithe.
6	—	1	—	1	—	4	—	—	1	2	—	5	1	34	2	Lambeth.
—	—	—	—	1	—	1	—	3	—	4	—	—	—	13	—	Battersea.
1	—	2	1	—	—	5	—	1	—	—	—	2	—	13	1	Wandsworth.
4	—	6	1	8	—	2	2	7	—	2	—	2	—	51	6	Camberwell.
—	—	—	—	3	—	2	—	1	—	—	1	—	—	6	1	Greenwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Woolwich.
2	—	3	1	1	—	2	1	2	—	—	—	—	—	13	2	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

§ Including Inner Temple (population, 96). ‖ Including Tower of London (population 868).

	Sanitary Areas.	Population (1891).	Oct. 5. Cases.	Oct. 5. Deaths.	Oct. 12. Cases.	Oct. 12. Deaths.	Oct. 19. Cases.	Oct. 19. Deaths.	Oct. 26. Cases.	Oct. 26. Deaths.	Nov. 2. Cases.	Nov. 2. Deaths.	Nov. 9. Cases.	Nov. 9. Deaths.	Nov. 16. Cases.	Nov. 16. Deaths.
			SMALL-POX—*continued.* Weekly Statement, 4th Quarter, 1895.													
	London	4,232,118	[a]24	1	16	2	8	1	6	1	12	1	11	1	12	—
	(*Administrative County*)	-	*[b]19*	—	*15*	—	*7*	—	*6*	—	*10*	—	*9*	—	*9*	—
W. District.	Kensington	166,308	—	—	—	—	—	—	—	—	—	—	—	—	2	—
	Fulham	91,639	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Hammersmith	97,239	—	—	—	—	—	—	—	—	—	—	1	—	—	—
	Paddington	117,846	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Chelsea	96,253	—	—	—	—	—	—	—	1	—	—	—	—	—	—
	St. George, Hanover Sq.*	78,599	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Westminster	55,539	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. James, Westminster	24,995	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	—	—	1	—	—	—	—	—	—	—	—	—	—	—
	Hampstead	68,416	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Pancras	234,379	—	—	—	—	—	—	—	—	—	—	—	—	1	—
	Islington	319,143	—	—	1	—	—	—	—	—	—	—	—	—	—	—
	St. Mary, Stoke Newington	30,936	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Hackney	198,606	1	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Strand†	25,217	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Holborn‡	34,043	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Clerkenwell	66,216	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Luke, Middlesex	42,440	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	London, City of§	37,583	—	—	—	—	—	—	—	—	—	—	—	—	1	—
E. District.	Shoreditch	124,009	—	—	3	—	—	—	—	—	—	—	—	—	—	—
	Bethnal Green	129,132	11	—	—	1	1	1	—	—	1	—	—	—	2	—
	Whitechapel‖	74,420	1	—	1	—	—	—	—	—	—	—	—	—	—	—
	St. George-in-the-East	45,795	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Limehouse	57,376	1	—	—	1	—	—	1	—	—	—	2	—	—	—
	Mile End Old Town	107,592	1	—	1	—	—	—	—	—	2	—	—	—	—	—
	Poplar	166,748	1	—	—	—	—	—	—	—	1	—	1	—	3	—
S. District.	St. Saviour, Southwark	27,177	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Southwark	59,712	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Newington	115,804	1	—	1	—	—	—	1	—	—	—	—	1	—	—
	St. Olave, Southwark	12,723	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Bermondsey	84,682	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Rotherhithe	39,255	1	—	—	—	2	—	—	—	—	—	—	—	—	—
	Lambeth	275,203	1	—	—	—	1	—	—	—	1	—	—	—	1	—
	Battersea	150,558	1	—	1	—	—	—	1	—	—	1	—	—	—	—
	Wandsworth	156,942	—	1	2	—	—	—	1	—	1	—	—	—	—	—
	Camberwell	235,344	3	—	2	—	2	—	2	—	5	—	4	—	2	—
	Greenwich	165,413	—	—	1	—	1	—	—	—	1	—	3	—	—	—
	Lewisham	92,647	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Woolwich	40,848	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Plumstead	52,436	1	—	1	—	1	—	—	—	—	—	—	—	—	—
	Lee	36,103	—	—	1	—	—	—	—	—	—	—	—	—	—	—
	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications.*
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 96).

SMALL-POX—*continued.*

Weekly Statement, 4th Quarter, 1895—*continued.* Nov. 23.		Nov. 30.		Dec. 7.		Dec. 14.		Dec. 21.		Dec. 28.		Totals for 4th Quarter, 1895.		Grand Totals for Year 1895.		Sanitary Areas.
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
9	—	5	1	8	1	16	1	3	—	6	1	136	11	1,080	55	London.
9	—	*5*	—	*8*	—	*14*	—	*3*	—	*6*	—	*122*	—	*984*	—	(*Administrative County.*)
—	—	—	—	—	—	—	—	—	—	—	—	2	—	12	—	Kensington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	Fulham.
1	—	—	—	—	—	—	—	—	—	—	—	2	—	8	1	Hammersmith.
—	—	—	—	—	—	—	—	—	—	1	—	1	—	13	—	Paddington.
—	—	—	—	—	—	—	—	—	—	—	—	—	1	5	1	Chelsea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	1	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	—	—	6	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	St. James, Westminster.
—	—	—	—	2	—	1	—	—	—	—	—	4	—	115	9	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	Hampstead.
—	—	1	—	—	—	—	—	—	—	—	—	2	—	17	1	St. Pancras.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	25	1	Islington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Mary, Stoke Newington.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	18	1	Hackney.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	14	2	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	1	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	2	Strand.†
—	—	—	—	—	—	—	—	—	—	—	—	—	—	40	—	Holborn.‡
—	—	—	—	—	—	—	—	—	—	—	—	—	—	12	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	6	—	London, City of.§
—	—	—	—	—	—	—	—	—	—	—	—	3	—	19	2	Shoreditch.
—	—	—	—	2	—	—	—	—	—	—	—	17	2	111	4	Bethnal Green.
—	—	—	—	—	—	1	—	—	—	—	—	3	—	109	4	Whitechapel.‖
—	—	—	—	—	—	—	—	—	—	—	—	—	—	20	—	St. George-in-the-East.
1	—	1	—	1	—	—	—	—	—	—	—	7	1	24	1	Limehouse.
1	—	—	—	—	—	—	—	—	—	—	—	5	—	56	1	Mile End Old Town.
2	—	—	—	1	—	2	—	—	—	—	—	11	—	30	1	Poplar.
—	—	—	—	—	—	—	—	—	—	1	—	1	—	4	—	St. Saviour, Southwark.
2	—	—	—	—	—	1	—	—	—	—	—	3	—	50	—	St. George, Southwark.
—	—	—	—	1	—	2	1	—	—	1	—	7	2	23	4	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	8	—	Bermondsey.
—	—	—	—	—	—	2	—	—	—	—	—	5	—	48	1	Rotherhithe.
—	—	—	—	—	—	1	—	—	—	1	—	6	—	64	2	Lambeth.
—	—	—	—	—	—	—	—	—	—	—	—	3	1	25	1	Battersea.
—	—	1	—	—	—	—	—	—	—	—	—	5	1	18	2	Wandsworth.
1	—	—	1	—	—	—	—	—	—	—	—	21	1	87	7	Camberwell.
1	—	2	—	1	1	5	—	3	—	2	1	20	2	43	3	Greenwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Woolwich.
—	—	—	—	—	—	—	—	—	—	—	—	3	—	18	2	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	5	—	Lee.
—	—	—	—	—	—	1	—	—	—	—	—	1	—	2	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

District	Sanitary Areas.	Population (1891).	Scarlet Fever. Weekly Statement, 1st Quarter, 1895. Jan. 5. Cases.	Jan. 5. Deaths.	Jan. 12. Cases.	Jan. 12. Deaths.	Jan. 19. Cases.	Jan. 19. Deaths.	Jan. 26. Cases.	Jan. 26. Deaths.	Feb. 2. Cases.	Feb. 2. Deaths.	Feb. 9. Cases.	Feb. 9. Deaths.
	London - - - -	4,232,118	194	14	216	12	244	9	255	7	234	11	257	15
	(*Administrative County*) -	- -	*189*	—	*212*	—	*237*	—	*254*	—	*231*	—	*248*	—
W. District.	Kensington - - -	166,308	8	1	1	—	8	—	7'	—	1	—	9	—
	Fulham - - -	91,639	9	3	8	—	4	—	3	—	15	—	5	—
	Hammersmith - -	97,239	6	—	2	—	5	—	6	1	2	—	6	—
	Paddington - - -	117,846	3	—	6	1	2	—	2	—	2	—	7	—
	Chelsea - - -	96,253	7	—	1	1	3	1	5	—	3	—	4	—
	St. George, Hanover Sq.* -	78,599	1	—	3	—	2	—	5	—	5	—	5	1
	Westminster - -	55,539	1	—	4	—	1	—	4	—	3	—	2	—
	St. James, Westminster -	24,995	4	—	2	—	1	—	—	—	4	—	1	—
N. District.	St. Marylebone - -	142,404	1	—	5	—	8	—	7	—	8	—	10	1
	Hampstead - - -	68,416	5	—	—	—	6	—	3	—	6	—	7	1
	St. Pancras - - -	234,379	11	2	9	—	16	3	20	1	21	—	13	2
	Islington - - -	319,143	8	1	19	1	27	—	24	1	22	3	43	2
	St. Mary, Stoke Newington	30,936	1	—	4	—	3	—	3	—	1	—	2	—
	Hackney - - -	198,606	10	1	6	—	7	—	9	—	7	—	5	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	1	—	2	—	1	—	1	1	1	—
	St. Martin-in-the-Fields -	14,616	—	—	1	—	1	—	—	—	—	—	1	—
	Strand† - - -	25,217	—	—	—	—	—	—	—	—	—	—	—	—
	Holborn‡ - - -	34,043	1	—	2	—	2	—	—	—	1	1	2	—
	Clerkenwell - - -	66,216	3	—	1	1	6	—	2	—	2	—	3	—
	St. Luke, Middlesex -	42,440	2	—	3	1	2	—	1	—	2	—	—	—
	London, City of§ - -	37,583	—	1	2	—	1	—	—	—	—	—	1	—
E. District.	Shoreditch - - -	124,009	4	—	4	—	6	1	3	—	3	—	7	—
	Bethnal Green - -	129,132	6	—	12	1	8	—	8	—	9	1	4	1
	Whitechapel‖ - -	74,420	5	—	8	—	2	—	3	—	5	—	1	—
	St. George-in-the-East -	45,795	2	—	2	—	2	1	3	1	3	—	2	—
	Limehouse - - -	57,376	5	—	3	1	2	—	16	—	3	—	11	—
	Mile End Old Town -	107,592	4	1	14	1	17	1	11	—	7	—	10	1
	Poplar - - -	166,748	11	1	14	1	15	—	29	1	13	3	16	—
S. District.	St. Saviour, Southwark -	27,177	1	—	—	—	1	—	1	—	2	—	—	—
	St. George, Southwark -	59,712	—	—	3	—	1	—	2	—	4	—	5	—
	Newington - - -	115,804	8	—	7	—	11	—	6	—	4	—	7	1
	St. Olave, Southwark -	12,723	—	—	—	—	—	—	3	—	—	—	1	—
	Bermondsey - -	84,682	9	—	1	1	4	—	5	1	—	—	5	—
	Rotherhithe - - -	39,255	6	—	5	—	1	—	7	—	6	—	8	1
	Lambeth - - -	275,203	13	1	11	—	4	1	5	—	10	1	7	—
	Battersea - - -	150,558	10	—	10	1	11	—	7	—	15	—	9	1
	Wandsworth - -	156,942	6	—	7	—	20	—	10	—	6	—	5	—
	Camberwell - - -	235,344	5	—	7	1	6	1	11	—	10	—	6	2
	Greenwich - - -	165,413	12	—	16	—	13	—	7	—	12	—	13	—
	Lewisham - - -	92,647	—	—	1	—	5	—	3	1	2	—	4	1
	Woolwich - - -	40,848	1	1	—	—	—	—	2	—	—	—	—	—
	Plumstead - - -	52,436	4	1	11	—	7	—	9	—	13	1	9	—
	Lee - - - -	36,103	1	—	—	—	1	—	2	—	1	—	—	—
	Port of London - -	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications*.
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

SCARLET FEVER—*continued.*

Feb. 16. Cases.	Feb. 16. Deaths.	Feb. 23. Cases.	Feb. 23. Deaths.	March 2. Cases.	March 2. Deaths.	March 9. Cases.	March 9. Deaths.	March 16. Cases.	March 16. Deaths.	March 23. Cases.	March 23. Deaths.	March 30. Cases.	March 30. Deaths.	Totals for 1st Quarter, 1895. Cases.	Totals for 1st Quarter, 1895. Deaths.	Sanitary Areas.
																Weekly Statement, 1st Quarter, 1895—*continued.*
294	18	223	10	218	7	202	6	221	4	257	15	237	13	3,052	141	London.
282	—	*219*	—	*208*	—	*194*	—	*212*	—	*245*	—	*231*	—	*2,962*	—	(*Administrative County.*)
9	1	5	—	2	—	5	—	4	—	10	—	6	—	75	2	Kensington.
3	1	3	1	9	1	12	—	5	—	8	—	10	2	94	8	Fulham.
4	—	1	1	1	—	2	—	4	—	10	—	7	—	56	2	Hammersmith.
8	2	6	—	6	—	3	—	1	—	2	1	1	—	49	4	Paddington.
4	—	7	—	3	1	9	—	—	—	2	1	5	—	53	4	Chelsea.
2	—	3	—	—	—	1	—	5	—	4	—	5	—	41	1	St. George, Hanover Sq.*
1	—	4	—	1	—	—	—	3	—	2	—	1	—	27	—	Westminster.
1	—	1	—	4	—	—	—	—	—	4	—	1	—	23	—	St. James, Westminster.
8	—	6	1	4	1	7	1	4	—	16	—	11	1	95	5	St. Marylebone.
10	—	15	—	4	—	8	—	6	—	5	—	2	1	77	2	Hampstead.
14	1	14	—	18	1	17	—	17	—	16	1	14	2	200	13	St. Pancras.
36	—	33	2	29	3	17	2	28	—	25	4	29	3	390	22	Islington.
7	—	1	—	1	—	—	—	3	—	2	—	—	—	28	—	St. Mary, Stoke Newington.
11	3	6	—	9	—	4	—	14	—	14	1	5	—	107	5	Hackney.
1	—	1	—	—	—	—	—	2	—	1	—	—	—	11	1	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	1	—	1	—	—	—	5	—	St. Martin-in-the-Fields.
—	—	—	—	1	—	3	—	1	—	2	—	3	1	10	1	Strand.†
1	—	1	—	—	—	2	—	1	—	—	—	—	—	13	1	Holborn.‡
4	1	4	—	2	—	3	—	1	—	2	1	6	—	39	3	Clerkenwell.
3	—	6	—	2	—	—	—	1	—	2	1	—	—	26	2	St. Luke, Middlesex.
—	—	1	—	—	—	—	—	—	—	1	—	1	—	7	1	London, City of.§
5	—	2	—	8	—	4	—	—	1	4	—	6	—	56	2	Shoreditch.
3	—	6	—	6	—	4	—	4	—	8	—	4	—	84	3	Bethnal Green.
3	—	1	—	4	—	5	—	1	—	1	—	3	—	44	—	Whitechapel.‖
—	—	—	—	4	—	1	—	4	—	—	—	3	—	26	2	St. George-in-the-East.
5	—	6	1	2	—	5	—	10	—	—	—	5	—	73	2	Limehouse.
9	—	8	—	7	—	9	—	11	—	5	—	3	—	115	4	Mile End Old Town.
10	1	11	—	8	—	8	—	17	—	15	1	14	1	181	9	Poplar.
1	1	—	—	2	—	—	—	—	—	1	—	—	—	9	1	St. Saviour, Southwark.
—	—	4	2	3	—	—	—	3	—	1	—	2	—	28	2	St. George, Southwark.
4	1	6	—	5	—	3	—	7	—	2	1	4	—	74	3	Newington.
1	—	—	—	1	—	—	—	—	—	—	—	—	—	6	—	St. Olave, Southwark.
4	1	3	—	3	—	5	—	2	—	4	—	6	—	51	3	Bermondsey.
3	—	9	—	6	—	4	—	8	—	6	—	2	—	71	1	Rotherhithe.
13	1	7	—	17	—	11	1	10	—	11	1	11	—	130	6	Lambeth.
9	—	3	1	8	—	10	—	3	1	15	—	11	—	121	4	Battersea.
2	1	10	1	6	—	11	1	10	—	16	—	18	—	127	3	Wandsworth.
10	1	6	—	6	—	15	1	20	1	22	—	13	1	137	8	Camberwell.
19	2	12	—	9	—	9	—	3	—	10	1	12	—	147	3	Greenwich.
3	—	—	—	1	—	—	—	2	—	1	—	2	—	24	2	Lewisham.
1	—	2	—	4	—	—	—	—	—	1	—	2	—	13	1	Woolwich.
2	—	5	—	11	—	4	—	4	—	3	1	7	1	89	4	Plumstead.
4	—	4	—	1	—	1	—	1	1	2	—	2	—	20	1	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

District	Sanitary Areas.	Population (1891).	April 6. Cases.	April 6. Deaths.	April 13. Cases.	April 13. Deaths.	April 20. Cases.	April 20. Deaths.	April 27. Cases.	April 27. Deaths.	May 4. Cases.	May 4. Deaths.	May 11. Cases.	May 11. Deaths.
			SCARLET FEVER—*continued.* Weekly Statement, 2nd Quarter, 1895.											
	London	4,232,118	[a]211	11	174	15	233	9	237	9	194	13	247	11
	(*Administrative County*)	-	[b]*202*	—	*169*	—	*230*	—	*226*	—	*188*	—	*233*	—
W. District.	Kensington	166,308	7	—	1	1	9	1	4	1	7	—	8	2
W. District.	Fulham	91,639	9	—	5	1	2	—	2	—	3	2	4	—
W. District.	Hammersmith	97,239	3	—	1	—	3	—	6	—	2	—	6	1
W. District.	Paddington	117,846	3	—	3	—	5	—	12	—	4	—	5	—
W. District.	Chelsea	96,253	3	—	6	—	9	1	8	—	4	—	6	—
W. District.	St. George, Hanover Sq.*	78,599	4	—	1	1	2	—	1	—	6	—	8	—
W. District.	Westminster	55,539	1	—	1	—	2	—	2	—	2	—	3	—
W. District.	St. James, Westminster	24,995	3	—	—	—	—	—	—	—	—	1	—	—
N. District.	St. Marylebone	142,404	7	—	5	1	10	—	7	—	9	—	11	—
N. District.	Hampstead	68,416	5	—	2	—	4	—	6	1	2	—	5	—
N. District.	St. Pancras	234,379	8	—	5	1	8	1	28	—	9	1	11	1
N. District.	Islington	319,143	26	2	20	2	17	—	19	2	12	1	14	2
N. District.	St. Mary, Stoke Newington	30,936	1	—	1	—	3	—	—	—	1	—	3	—
N. District.	Hackney	198,606	13	2	11	—	10	1	7	—	8	—	14	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	1	—	—	—	—	—	1	—
Central District.	St. Martin-in-the-Fields	14,616	—	—	1	—	1	—	—	—	1	—	—	—
Central District.	Strand†	25,217	—	—	—	—	—	—	—	—	2	—	—	—
Central District.	Holborn‡	34,043	1	—	2	—	4	—	2	—	1	—	1	—
Central District.	Clerkenwell	66,216	1	—	2	—	2	—	3	—	2	—	3	—
Central District.	St. Luke, Middlesex	42,440	6	—	—	—	—	—	1	—	—	—	—	—
Central District.	London, City of§	37,583	1	—	—	—	1	—	—	—	1	1	—	—
E. District.	Shoreditch	124,009	4	—	4	1	7	—	6	1	6	—	3	—
E. District.	Bethnal Green	129,132	2	1	3	—	6	1	2	1	6	—	2	—
E. District.	Whitechapel‖	74,420	5	—	1	—	1	—	4	—	2	1	4	—
E. District.	St. George-in-the-East	45,795	2	—	5	—	2	—	4	—	4	—	5	1
E. District.	Limehouse	57,376	6	—	2	—	4	—	4	—	5	1	3	1
E. District.	Mile End Old Town	107,592	—	1	5	—	6	—	5	—	3	—	2	—
E. District.	Poplar	166,748	12	1	15	—	17	—	19	—	8	2	12	1
S. District.	St. Saviour, Southwark	27,177	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. George, Southwark	59,712	2	—	1	—	—	—	2	—	1	—	4	—
S. District.	Newington	115,804	2	1	2	1	4	—	3	—	4	—	11	—
S. District.	St. Olave, Southwark	12,723	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Bermondsey	84,682	4	—	4	—	7	1	3	—	10	—	5	—
S. District.	Rotherhithe	39,255	8	—	1	1	4	—	3	—	3	—	10	—
S. District.	Lambeth	275,203	16	1	8	1	12	—	20	1	16	—	18	—
S. District.	Battersea	150,558	4	—	9	—	10	—	14	1	3	—	4	—
S. District.	Wandsworth	156,942	6	—	9	1	7	—	9	—	9	1	16	—
S. District.	Camberwell	235,344	10	—	8	2	10	1	9	1	12	1	11	1
S. District.	Greenwich	165,413	13	1	9	—	16	1	11	—	13	—	23	1
S. District.	Lewisham	92,647	—	—	1	—	8	—	5	—	1	—	1	—
S. District.	Woolwich	40,848	5	1	2	1	1	—	2	—	4	—	4	—
S. District.	Plumstead	52,436	4	—	17	—	9	1	4	—	5	—	3	—
S. District.	Lee	36,103	4	—	1	—	9	—	—	—	3	1	3	—
S. District.	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications.*
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

Scarlet Fever—*continued.*																
Weekly Statement, 2nd Quarter, 1895—*continued.*														Totals for 2nd Quarter, 1895.		Sanitary Areas.
May 18.		May 25.		June 1.		June 8.		June 15.		June 22.		June 29.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
270	13	287	10	286	17	283	17	326	12	341	11	456	18	3,545	166	London.
259	—	*260*	—	*276*	—	*278*	—	*317*	—	*338*	—	*448*	—	*3,438*	—	(*Administrative County.*
3	1	6	—	9	—	10	1	8	—	4	—	8	—	84	7	Kensington.
3	—	4	—	7	—	3	—	9	—	9	—	4	1	64	4	Fulham.
7	—	1	—	8	1	4	—	5	—	5	1	6	—	57	3	Hammersmith.
1	—	6	1	8	1	9	—	8	—	14	—	16	—	94	2	Paddington.
11	1	4	—	11	—	15	—	8	—	10	—	11	—	106	2	Chelsea.
5	—	5	—	2	—	5	—	2	—	4	—	15	—	60	1	St. George, Hanover Sq.*
1	—	1	—	2	—	3	—	3	—	6	2	7	—	34	2	Westminster.
—	—	1	—	2	—	1	—	—	—	1	—	5	—	13	1	St. James, Westminster.
8	—	8	—	9	1	3	—	10	—	10	—	9	1	106	3	St. Marylebone.
2	—	3	—	5	—	5	—	3	—	7	1	8	—	57	2	Hampstead.
23	—	14	—	8	1	16	1	18	1	14	—	22	2	184	9	St. Pancras.
18	2	11	—	20	1	21	—	25	—	27	—	40	1	270	13	Islington.
6	—	1	—	5	—	—	—	2	—	4	—	4	—	31	—	St. Mary, Stoke Newington.
11	1	17	1	14	2	10	1	18	2	23	1	27	3	163	14	Hackney.
—	—	3	—	2	—	4	1	5	—	4	—	3	—	23	1	St. Giles and St. George, Bloomsbury.
—	—	1	—	—	—	—	—	—	—	1	—	1	—	6	—	St. Martin-in-the-Fields.
1	—	—	—	—	—	1	—	—	1	1	—	1	—	6	1	Strand.†
—	—	2	—	—	—	2	—	1	—	3	—	5	—	24	—	Holborn.‡
3	—	11	—	2	1	5	1	14	—	7	—	10	2	65	4	Clerkenwell.
1	—	1	—	1	—	1	—	—	—	5	—	9	—	25	—	St. Luke, Middlesex.
1	—	2	—	2	1	2	—	—	—	2	—	5	—	17	2	London, City of.§
13	—	9	—	12	—	10	1	8	—	9	1	13	—	104	4	Shoreditch.
3	—	9	—	10	—	7	1	9	2	9	—	22	1	90	7	Bethnal Green
6	—	5	—	6	—	3	—	1	—	10	1	8	1	56	3	Whitechapel.‖
3	—	6	1	7	2	3	2	6	—	3	—	8	1	58	7	St. George-in-the-East.
6	1	3	3	2	—	4	—	8	—	4	—	8	1	59	7	Limehouse.
5	—	5	—	9	1	8	—	21	2	5	—	9	—	83	4	Mile End Old Town.
2	—	9	—	10	1	13	—	18	—	18	—	19	2	172	7	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	4	—	4	—	St. Saviour, Southwark.
3	—	1	—	—	—	5	—	6	2	1	—	1	—	27	2	St. George, Southwark.
4	1	8	1	6	—	1	—	6	—	7	—	5	—	63	4	Newington.
1	—	—	—	1	—	—	—	—	—	—	—	—	—	2	—	St. Olave, Southwark.
10	1	8	—	2	—	4	—	6	—	2	—	6	—	71	2	Bermondsey.
8	1	7	—	3	2	11	—	5	—	2	—	4	—	60	4	Rotherhithe.
20	2	25	1	29	—	21	—	13	1	18	1	33	1	249	9	Lambeth.
12	—	25	1	12	—	19	4	21	—	15	2	25	—	173	8	Battersea.
12	—	12	—	13	—	11	1	18	—	13	—	15	—	150	3	Wandsworth.
12	1	13	—	11	1	10	—	14	1	19	—	15	—	154	9	Camberwell.
23	1	16	—	17	1	8	2	16	—	23	—	23	1	211	8	Greenwich.
3	—	8	—	5	—	11	—	—	—	6	—	7	—	56	—	Lewisham.
5	—	5	—	4	—	5	1	3	—	12	—	5	—	57	3	Woolwich.
9	—	9	—	8	—	5	—	7	—	4	1	8	—	92	2	Plumstead.
5	—	2	1	2	—	4	—	1	—	—	—	2	—	36	2	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

§ Including Inner Temple (population 96).

‖ Including Tower of London (population, 868).

District	Sanitary Areas.	Population (1891).	SCARLET FEVER—*continued.* Weekly Statement, 3rd Quarter, 1895. July 6. Cases.	July 6. Deaths.	July 13. Cases.	July 13. Deaths.	July 20. Cases.	July 20. Deaths.	July 27. Cases.	July 27. Deaths.	Aug. 3. Cases.	Aug. 3. Deaths.	Aug. 10. Cases.	Aug. 10. Deaths.
	London	4,232,118	[a]445	12	469	20	551	23	569	14	461	24	462	15
	(*Administrative County*)	-	[b]*435*	—	*462*	—	*529*	—	*534*	—	*498*	—	*435*	—
W. District.	Kensington	166,308	13	—	14	1	20	—	12	—	9	—	5	—
W. District.	Fulham	91,639	4	1	4	1	10	—	14	—	4	1	5	—
W. District.	Hammersmith	97,239	4	—	13	—	17	—	14	1	7	1	4	—
W. District.	Paddington	117,846	10	2	11	1	17	—	18	—	10	—	12	—
W. District.	Chelsea	96,253	17	1	12	1	18	2	25	—	14	1	21	3
W. District.	St. George, Hanover Sq.*	78,599	14	—	7	—	9	—	24	1	10	1	5	—
W. District.	Westminster	55,539	2	—	7	—	8	—	8	1	3	—	—	—
W. District.	St. James, Westminster	24,995	2	—	2	—	—	—	2	—	—	1	—	—
N. District.	St. Marylebone	142,404	5	—	11	—	9	—	13	—	16	—	7	—
N. District.	Hampstead	68,416	9	—	10	—	10	—	15	—	8	—	1	—
N. District.	St. Pancras	234,379	23	—	35	1	28	—	41	—	33	2	28	1
N. District.	Islington	319,143	35	—	55	1	53	4	53	1	27	2	36	1
N. District.	St. Mary, Stoke Newington	30,936	—	—	3	—	4	—	1	—	1	—	2	—
N. District.	Hackney	198,606	20	1	15	2	25	2	14	1	31	—	17	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	5	—	5	—	8	—	6	—	5	—	5	—
Central District.	St. Martin-in-the-Fields	14,616	1	—	2	—	—	—	1	—	—	1	—	—
Central District.	Strand†	25,217	3	—	5	—	11	1	—	—	3	1	4	—
Central District.	Holborn‡	34,043	1	—	1	—	1	—	1	—	2	—	4	—
Central District.	Clerkenwell	66,216	6	1	6	—	7	—	5	—	4	—	5	—
Central District.	St. Luke, Middlesex	42,440	1	—	2	—	1	1	4	1	4	—	4	—
Central District.	London, City of§	37,583	13	—	3	—	2	—	5	—	5	—	3	1
E. District.	Shoreditch	124,009	18	—	21	2	23	2	19	—	20	1	22	1
E. District.	Bethnal Green	129,132	17	1	18	1	6	—	10	—	17	2	22	1
E. District.	Whitechapel‖	74,420	15	—	5	1	15	—	22	—	21	—	19	—
E. District.	St. George-in-the-East	45,795	7	—	4	—	10	—	18	—	18	1	10	1
E. District.	Limehouse	57,376	9	—	13	1	20	1	15	1	17	—	19	1
E. District.	Mile End Old Town	107,592	10	—	16	—	18	1	20	—	21	—	31	2
E. District.	Poplar	166,748	20	2	19	2	32	—	22	1	18	1	25	1
S. District.	St. Saviour, Southwark	27,177	—	—	4	1	4	1	4	—	3	2	7	—
S. District.	St. George, Southwark	59,712	3	—	3	—	7	1	5	—	3	—	1	1
S. District.	Newington	115,804	8	—	5	—	7	—	16	1	9	1	3	—
S. District.	St. Olave, Southwark	12,723	1	—	—	—	—	—	1	—	1	—	1	—
S. District.	Bermondsey	84,682	11	—	7	—	6	1	8	1	4	—	15	—
S. District.	Rotherhithe	39,255	4	—	1	—	2	—	4	—	5	—	1	—
S. District.	Lambeth	275,203	21	—	25	—	37	2	35	—	28	1	27	1
S. District.	Battersea	150,558	17	2	10	—	18	2	31	1	17	1	21	—
S. District.	Wandsworth	156,942	10	—	22	1	22	—	6	—	8	1	17	—
S. District.	Camberwell	235,344	12	—	15	—	23	—	16	1	16	1	20	—
S. District.	Greenwich	165,413	36	—	31	2	17	2	17	1	21	—	27	—
S. District.	Lewisham	92,647	11	—	11	—	9	—	13	—	5	1	—	—
S. District.	Woolwich	40,848	13	1	7	1	3	—	5	1	7	—	1	—
S. District.	Plumstead	52,436	10	—	3	—	12	—	4	—	6	—	5	—
S. District.	Lee	36,103	4	—	6	—	2	—	2	—	—	—	—	—
S. District.	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications.*
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

Scarlet Fever—*continued.*

Weekly Statement, 3rd Quarter, 1895—*continued.*														Totals for 3rd Quarter, 1895.		Sanitary Areas.
Aug. 17.		Aug. 24.		Aug. 31.		Sept. 7.		Sept. 14.		Sept. 21.		Sept. 28.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
416	21	423	27	382	21	498	20	517	19	586	13	595	24	6,374	253	London.
395	—	*407*	—	*368*	—	*476*	—	*498*	—	*558*	—	*564*	—	*6,089*	—	(*Administrative County.*)
7	1	3	—	8	—	8	—	12	—	21	1	22	1	154	4	Kensington.
5	—	3	—	9	—	4	1	3	—	5	—	6	—	76	4	Fulham.
10	1	9	2	6	—	10	—	9	—	16	1	10	—	129	6	Hammersmith.
6	—	7	—	13	1	6	—	5	1	9	—	8	—	132	5	Paddington.
6	—	9	—	7	—	13	—	2	—	15	—	18	—	177	8	Chelsea.
5	—	3	—	1	1	4	—	7	—	5	—	11	1	105	4	St. George, Hanover Sq.*
1	—	4	—	4	—	3	—	5	—	7	—	5	—	57	1	Westminster.
—	—	4	—	2	—	2	—	—	—	2	—	1	—	17	1	St. James, Westminster.
14	—	9	—	11	—	10	—	18	—	27	—	20	1	170	1	St. Marylebone.
2	—	6	—	—	—	5	—	15	—	8	—	7	1	96	1	Hampstead.
26	—	26	1	21	1	35	1	30	2	28	—	43	2	397	11	St. Pancras.
32	1	35	3	31	—	46	1	33	2	48	2	44	1	528	19	Islington.
5	—	2	—	3	—	4	—	5	—	—	—	4	—	34	—	St. Mary, Stoke Newington.
21	1	27	—	22	—	24	1	23	2	22	—	28	2	289	12	Hackney.
5	1	7	—	2	—	5	—	4	—	6	—	4	—	67	1	St. Giles and St. George, Bloomsbury.
—	—	—	—	2	—	—	—	1	—	3	—	1	—	11	1	St. Martin-in-the-Fields.
6	—	5	—	2	2	7	1	1	—	6	—	4	1	57	6	Strand.†
5	—	4	—	1	—	3	—	6	—	10	—	7	—	46	—	Holborn.‡
5	—	9	2	7	—	9	1	23	1	6	—	11	—	103	5	Clerkenwell.
2	—	4	—	3	—	6	—	10	—	9	—	8	—	58	2	St. Luke, Middlesex.
3	—	2	—	3	—	5	—	5	—	14	—	7	—	70	1	London, City of.§
11	1	16	1	6	2	11	1	17	1	15	—	22	2	221	14	Shoreditch.
23	—	19	1	26	1	29	2	27	—	30	1	46	1	290	11	Bethnal Green.
19	—	17	1	16	—	25	1	25	—	33	2	16	3	248	8	Whitechapel.‖
4	1	10	1	6	—	11	1	12	1	13	—	11	—	134	6	St. George-in-the-East.
17	1	6	1	8	3	9	1	10	—	7	—	14	—	164	10	Limehouse.
14	1	21	2	21	—	30	1	27	—	21	—	18	2	268	9	Mile End Old Town.
23	4	27	2	25	1	21	1	27	1	16	—	36	2	311	18	Poplar.
2	—	7	—	3	—	—	—	6	—	4	—	6	—	59	4	St. Saviour, Southwark.
5	1	3	1	7	—	—	—	6	—	4	—	10	1	57	5	St. George, Southwark.
6	—	6	—	11	1	12	1	8	1	11	—	5	1	107	6	Newington.
—	—	1	—	1	—	—	—	—	—	—	—	—	—	6	—	St. Olave, Southwark.
13	1	9	—	6	2	8	—	5	1	7	—	3	—	102	6	Bermondsey.
2	—	8	—	1	—	9	—	—	—	9	—	3	—	49	—	Rotherhithe.
37	1	25	2	29	—	38	2	41	3	43	1	44	1	430	14	Lambeth.
20	2	9	1	9	1	19	1	8	1	20	1	25	—	224	13	Battersea.
3	—	11	—	6	1	11	—	17	—	19	2	15	—	167	5	Wandsworth.
17	—	25	2	29	3	18	1	26	1	30	1	17	—	264	10	Camberwell.
25	2	9	3	6	1	21	1	17	1	21	1	12	—	260	14	Greenwich.
3	—	1	1	3	—	10	—	4	—	10	—	8	1	88	3	Lewisham.
3	—	—	—	3	—	1	—	6	—	4	—	6	—	59	3	Woolwich.
2	1	10	—	2	—	3	—	6	—	1	—	7	—	71	1	Plumstead.
1	—	5	—	—	—	3	—	5	—	1	—	2	—	31	—	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

Sanitary Areas.		Population (1891).	SCARLET FEVER—*continued*. Weekly Statement, 4th Quarter, 1895. Oct. 5.		Oct. 12.		Oct. 19.		Oct. 26.		Nov. 2.		Nov. 9.		Nov. 16.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
London		4,232,118	[a] 655	22	649	25	706	23	678	19	667	23	696	19	587	14
(*Administrative County*)		-	[b] *608*	—	*623*	—	*647*	—	*639*	—	*637*	—	*642*	—	*556*	—
W. District.	Kensington	166,308	14	—	24	2	28	1	21	—	23	1	24	3	17	1
	Fulham	91,639	12	—	14	—	7	1	13	1	18	2	8	—	11	—
	Hammersmith	97,239	21	1	9	2	20	—	12	—	15	—	12	—	7	—
	Paddington	117,846	19	—	15	—	23	1	9	—	13	—	11	—	10	—
	Chelsea	96,253	19	2	20	—	24	—	22	—	24	2	27	—	17	—
	St. George, Hanover Sq.*	78,599	7	1	20	—	14	1	6	—	9	—	8	—	12	—
	Westminster	55,539	7	—	13	1	6	—	10	1	10	—	5	—	4	—
	St. James, Westminster	24,995	3	—	—	—	7	—	1	—	1	—	3	—	3	—
N. District.	St. Marylebone	142,404	31	—	27	1	20	1	20	—	11	1	10	—	11	—
	Hampstead	68,416	7	—	10	—	5	—	11	—	5	—	8	1	10	—
	St. Pancras	234,379	29	—	34	1	29	1	19	4	40	1	51	5	32	1
	Islington	319,143	46	—	48	1	62	—	56	1	60	2	54	1	45	2
	St. Mary, Stoke Newington	30,936	7	—	4	—	9	—	7	—	3	1	2	—	4	—
	Hackney	198,606	37	1	32	2	31	1	41	—	47	—	45	—	49	1
Central District.	St. Giles and St. George, Bloomsbury.	39,782	6	1	3	—	5	1	11	—	5	—	3	—	5	—
	St. Martin-in-the-Fields	14,616	—	—	2	—	3	—	3	1	1	—	—	—	—	—
	Strand†	25,217	5	—	7	—	7	1	3	—	3	—	6	—	1	—
	Holborn‡	34,043	5	—	8	—	8	—	10	1	7	—	18	—	4	—
	Clerkenwell	66,216	14	—	11	—	14	—	9	1	13	—	13	—	21	—
	St. Luke, Middlesex	42,440	3	—	4	—	6	—	12	—	7	1	2	—	2	—
	London, City of§	37,583	1	—	3	—	8	—	8	—	15	—	7	—	2	—
E. District.	Shoreditch	124,009	20	1	19	—	22	—	23	1	17	3	19	—	18	1
	Bethnal Green	129,132	31	3	24	—	17	2	46	1	35	1	47	1	20	—
	Whitechapel‖	74,420	21	—	14	1	21	3	16	—	20	—	23	1	24	—
	St. George-in-the-East	45,795	10	—	3	—	9	2	9	1	9	—	4	—	3	—
	Limehouse	57,376	15	—	10	1	5	—	10	—	13	—	16	—	7	—
	Mile End Old Town	107,592	21	1	28	1	30	—	14	2	18	1	19	—	23	1
	Poplar	166,748	31	1	28	2	20	—	24	—	25	2	31	—	27	1
S. District.	St. Saviour, Southwark	27,177	8	—	6	—	3	—	4	—	4	—	1	—	2	—
	St. George, Southwark	59,712	2	1	5	—	11	1	10	—	9	—	1	1	3	—
	Newington	115,804	8	1	22	1	23	—	16	—	9	—	20	1	9	—
	St. Olave, Southwark	12,723	3	—	—	—	4	—	2	—	1	—	—	—	1	—
	Bermondsey	84,682	9	1	7	1	11	1	8	—	7	—	6	—	4	2
	Rotherhithe	39,255	7	—	6	—	6	—	4	—	17	—	9	1	10	—
	Lambeth	275,203	45	2	54	3	71	2	56	1	38	1	58	—	58	2
	Battersea	150,558	41	1	23	—	20	—	30	1	29	—	43	1	29	—
	Wandsworth	156,942	14	—	13	—	20	—	17	—	11	—	19	—	18	2
	Camberwell	235,344	20	2	20	3	34	1	32	1	31	1	20	—	28	—
	Greenwich	165,413	27	1	29	1	17	1	19	1	20	1	22	1	12	—
	Lewisham	92,647	8	—	11	—	3	—	7	—	3	1	3	—	10	—
	Woolwich	40,848	6	1	6	—	5	1	8	—	3	—	3	—	7	—
	Plumstead	52,436	6	—	9	—	7	—	10	—	9	1	6	1	5	—
	Lee	36,103	9	—	4	1	11	—	9	—	9	—	9	1	2	—
	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications*.
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

SCARLET FEVER—*continued.*

Weekly Statement, 4th Quarter, 1895—*continued.* Nov. 23.		Nov. 30.		Dec. 7.		Dec. 14.		Dec. 21.		Dec. 28.		Totals for 4th Quarter, 1895.		Grand Totals for Year 1895.		Sanitary Areas.
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
580	27	561	17	549	19	523	19	478	25	395	17	7,724	269	20,695	829	London.
541	—	*535*	—	*527*	—	*507*	—	*457*	—	*365*	—	*7,384*	—	*19,773*	—	(*Administrative County.*)
14	1	13	—	16	1	22	—	14	3	18	2	248	15	561	28	Kensington.
6	1	8	—	5	—	6	—	6	—	5	—	119	5	353	21	Fulham.
7	1	9	1	12	—	8	1	9	—	8	—	149	6	391	17	Hammersmith.
10	1	16	—	13	1	13	—	9	—	5	—	166	3	441	14	Paddington.
28	2	17	1	12	—	17	1	18	2	7	1	252	11	588	25	Chelsea.
5	—	5	1	11	—	7	—	11	—	9	1	124	4	330	10	St. George, Hanover Sq.*
2	1	4	—	2	—	3	—	1	—	2	—	69	3	187	6	Westminster.
5	1	3	—	4	—	8	—	2	—	1	—	41	1	94	3	St. James, Westminster.
24	—	3	—	9	1	13	—	12	—	5	1	196	5	567	14	St. Marylebone.
6	—	10	1	7	—	11	—	3	1	8	—	101	3	331	8	Hampstead.
31	2	37	1	24	—	18	—	17	2	8	1	369	19	1,150	52	St. Pancras.
46	1	55	1	49	—	33	—	41	2	31	2	626	13	1,814	67	Islington.
1	—	5	—	1	—	2	—	1	—	3	—	49	1	142	1	St. Mary, Stoke Newington.
52	—	36	1	43	1	35	3	33	—	21	—	502	10	1,081	41	Hackney.
4	1	6	—	3	—	3	—	3	—	5	—	62	3	163	6	St. Giles and St. George, Bloomsbury.
—	—	2	—	1	—	—	—	5	—	1	—	18	1	40	2	St. Martin-in-the-Fields.
1	—	—	—	—	—	2	—	3	—	1	—	39	1	112	9	Strand.†
4	2	12	—	—	1	3	—	2	1	3	—	84	5	167	6	Holborn.‡
11	1	4	—	10	2	5	—	5	1	9	—	139	5	346	17	Clerkenwell.
6	—	2	—	4	—	1	—	3	—	3	—	55	1	164	5	St. Luke, Middlesex.
3	—	9	—	1	—	7	—	2	—	4	—	70	—	164	4	London, City of.§
21	—	15	1	15	1	11	2	12	—	10	—	222	10	603	30	Shoreditch.
23	—	18	—	17	—	19	—	16	1	15	—	328	9	792	30	Bethnal Green.
8	—	11	—	19	3	19	2	9	2	8	—	213	12	561	23	Whitechapel.‖
10	—	11	—	13	1	9	—	9	—	11	1	11[illegible]	5	328	20	St. George-in-the-East.
10	—	10	—	9	—	7	—	5	—	5	—	122	1	418	20	Limehouse.
14	—	15	—	15	—	12	1	23	1	9	1	241	9	707	26	Mile End Old Town.
19	1	28	—	22	2	42	2	29	2	31	1	357	14	1,021	48	Poplar.
3	—	5	—	3	1	2	—	—	—	2	—	43	1	106	6	St. Saviour, Southwark.
10	1	2	—	7	—	5	1	6	—	3	—	74	5	186	14	St. George, Southwark.
11	—	16	—	18	—	9	—	8	—	18	—	187	3	431	16	Newington.
2	—	2	—	—	—	5	—	1	—	1	—	22	—	36	—	St. Olave, Southwark.
6	—	6	—	5	—	3	—	11	—	8	—	91	5	315	16	Bermondsey.
3	—	4	1	6	—	7	—	5	1	7	—	91	3	280	8	Rotherhithe.
53	5	41	2	48	1	48	—	40	2	32	3	644	24	1,453	53	Lambeth.
23	—	19	—	18	—	24	—	17	1	21	1	339	5	857	30	Battersea.
16	1	21	1	25	—	13	1	21	—	17	—	225	5	669	16	Wandsworth.
34	1	30	2	32	2	23	3	20	1	13	2	337	19	892	46	Camberwell.
19	2	17	—	23	—	22	2	21	1	12	—	260	11	878	36	Greenwich.
13	—	18	3	12	—	14	—	13	—	5	—	120	4	288	9	Lewisham.
4	1	7	—	5	1	4	—	5	—	—	—	63	4	192	11	Woolwich.
6	—	3	—	3	—	3	—	6	1	4	—	77	3	329	10	Plumstead.
2	—	6	—	7	—	5	—	1	—	6	—	80	2	167	5	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

District	Sanitary Areas.	Population (1891).	Jan. 5. Cases.	Jan. 5. Deaths.	Jan. 12. Cases.	Jan. 12. Deaths.	Jan. 19. Cases.	Jan. 19. Deaths.	Jan. 26. Cases.	Jan. 26. Deaths.	Feb. 2. Cases.	Feb. 2. Deaths.	Feb. 9. Cases.	Feb. 9. Deaths.
			Diphtheria. Weekly Statement, 1st Quarter, 1895.											
	London	4,232,118	a190	50	156	34	156	30	176	28	161	45	107	31
	(*Administrative County*)	-	b*178*	—	*152*	—	*155*	—	*170*	—	*154*	—	*104*	—
W. District.	Kensington	166,308	3	4	3	—	8	—	5	1	2	1	5	—
W. District.	Fulham	91,639	8	3	8	2	7	3	2	—	5	1	7	1
W. District.	Hammersmith	97,239	4	4	3	—	6	1	6	—	3	1	—	1
W. District.	Paddington	117,846	2	—	1	—	—	1	5	—	2	1	—	—
W. District.	Chelsea	96,253	1	—	4	—	5	4	6	—	—	2	4	1
W. District.	St. George, Hanover Sq.*	78,599	2	1	—	—	1	—	3	—	1	—	3	1
W. District.	Westminster	55,539	6	—	2	1	3	—	1	1	1	—	—	—
W. District.	St. James, Westminster	24,995	—	—	2	—	—	—	—	—	—	—	2	—
N. District.	St. Marylebone	142,404	6	—	5	—	7	1	4	—	2	—	5	—
N. District.	Hampstead	68,416	4	1	2	—	—	—	—	—	1	—	—	—
N. District.	St. Pancras	234,379	10	—	18	2	12	3	8	—	10	2	9	3
N. District.	Islington	319,143	15	3	9	1	13	—	18	6	14	7	8	2
N. District.	St. Mary, Stoke Newington	30,936	1	—	2	—	2	1	3	—	—	—	—	—
N. District.	Hackney	198,606	8	5	2	—	5	1	10	1	14	2	4	1
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	2	—	2	—	—	—	—	—
Central District.	St. Martin-in-the-Fields	14,616	1	1	—	—	—	—	—	—	—	—	—	—
Central District.	Strand†	25,217	2	1	—	—	1	2	—	—	1	—	—	—
Central District.	Holborn‡	34,043	1	—	1	—	—	—	—	—	—	—	1	—
Central District.	Clerkenwell	66,216	—	1	1	1	—	—	1	1	2	—	3	1
Central District.	St. Luke, Middlesex	42,440	4	—	4	—	1	—	1	—	2	1	3	—
Central District.	London, City of§	37,583	—	—	—	—	1	—	2	—	—	—	1	—
E. District.	Shoreditch	124,009	4	—	2	2	2	—	8	—	3	1	—	1
E. District.	Bethnal Green	129,132	8	2	5	3	3	2	8	1	6	—	6	—
E. District.	Whitechapel‖	74,420	5	1	—	1	3	—	7	—	5	—	2	—
E. District.	St. George-in-the-East	45,795	4	1	3	1	4	—	—	—	5	1	2	1
E. District.	Limehouse	57,376	6	1	2	2	3	1	1	—	2	—	4	3
E. District.	Mile End Old Town	107,592	6	3	5	3	3	—	5	2	10	3	2	—
E. District.	Poplar	166,748	13	4	6	2	5	1	12	6	12	3	5	4
S. District.	St. Saviour, Southwark	27,177	1	—	—	—	2	—	—	—	3	1	—	1
S. District.	St. George, Southwark	59,712	—	—	2	—	1	—	2	2	4	—	2	—
S. District.	Newington	115,804	2	3	9	2	4	1	5	1	4	3	1	—
S. District.	St. Olave, Southwark	12,723	1	—	—	—	—	—	—	—	—	—	—	—
S. District.	Bermondsey	84,682	4	—	4	—	2	—	1	—	—	—	—	—
S. District.	Rotherhithe	39,255	1	—	4	—	3	—	3	—	1	—	2	—
S. District.	Lambeth	275,203	15	1	11	4	15	2	5	1	6	1	2	2
S. District.	Battersea	150,558	9	4	11	1	7	—	5	1	12	2	1	3
S. District.	Wandsworth	156,942	1	—	6	1	4	1	3	1	2	1	2	1
S. District.	Camberwell	235,344	9	2	11	2	8	3	13	1	12	6	8	3
S. District.	Greenwich	165,413	13	3	4	2	1	1	13	2	8	1	11	4
S. District.	Lewisham	92,647	3	—	2	—	4	—	1	—	1	1	—	—
S. District.	Woolwich	40,848	3	1	—	—	2	1	1	—	1	—	—	—
S. District.	Plumstead	52,436	3	—	2	—	1	—	4	—	4	3	2	—
S. District.	Lee	36,103	—	—	—	1	2	—	2	—	—	—	—	—
S. District.	Port of London	—	1	—	—	—	—	—	—	—	—	—	—	—

a Totals of actual *notifications*.
b Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population 95).

Diphtheria—*continued*.

Weekly Statement, 1st Quarter, 1895—*continued*.														Totals for 1st Quarter, 1895.		Sanitary Areas.
Feb. 16.		Feb. 23.		March 2.		March 9.		March 16.		March 23.		March 30.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
125	27	107	27	100	31	116	33	136	27	139	23	131	31	1,800	420	London.
121	—	*102*	—	*95*	—	*108*	—	*129*	—	*131*	—	*130*	—	*1,733*	—	(*Administrative County.*)
3	—	1	1	5	—	2	1	6	1	6	2	7	—	56	11	Kensington.
1	—	4	—	2	1	3	—	5	2	6	—	6	1	64	14	Fulham.
4	—	1	—	1	1	1	—	3	—	5	—	5	1	42	9	Hammersmith.
—	—	6	2	3	1	1	—	2	3	1	—	—	—	23	8	Paddington.
3	—	2	—	3	—	1	1	2	—	4	—	4	—	42	8	Chelsea.
1	—	1	—	2	—	2	1	2	—	5	—	1	—	24	3	St. George, Hanover Sq.*
1	—	—	—	—	—	2	—	4	—	3	1	7	2	30	5	Westminster.
—	—	—	—	—	—	2	—	—	—	1	—	3	1	10	1	St. James, Westminster.
—	—	1	—	2	1	5	1	2	—	5	—	1	1	45	4	St. Marylebone.
—	—	1	—	3	1	1	—	3	—	—	—	3	—	18	2	Hampstead.
4	2	9	2	6	2	6	4	5	—	8	—	6	2	111	22	St. Pancras.
8	2	7	1	2	2	3	1	4	1	4	1	6	—	111	27	Islington.
1	—	—	—	—	—	1	—	—	—	—	—	1	—	11	1	St. Mary, Stoke Newington.
6	1	5	2	5	1	4	3	6	—	6	—	8	—	83	17	Hackney.
1	—	1	1	—	—	—	—	—	—	1	—	1	—	8	1	St. Giles and St. George, Bloomsbury.
1	—	—	—	—	—	—	—	4	2	—	—	—	1	6	4	St. Martin-in-the-Fields.
—	—	—	—	—	—	2	—	1	—	—	—	1	1	8	4	Strand.†
2	1	1	—	—	—	—	—	2	—	1	—	—	—	9	1	Holborn.‡
3	—	—	—	1	1	1	—	2	—	1	1	2	—	17	6	Clerkenwell.
1	—	3	1	—	1	—	—	1	—	1	—	1	—	22	3	St. Luke, Middlesex.
1	—	—	1	1	—	—	—	—	—	—	1	1	—	7	2	London, City of.§
1	—	1	—	3	—	1	1	3	—	3	1	3	1	34	7	Shoreditch.
3	1	5	—	6	1	2	3	4	—	4	1	3	—	63	14	Bethnal Green.
5	1	2	—	2	—	3	1	1	—	6	1	1	—	42	5	Whitechapel.‖
3	—	—	—	1	—	3	—	—	—	—	—	2	1	27	5	St. George-in-the-East.
4	—	1	1	1	1	2	—	4	—	1	1	3	—	34	10	Limehouse.
4	1	3	1	3	1	9	1	3	4	3	2	3	1	59	22	Mile End Old Town.
11	3	4	3	3	2	2	1	7	1	6	—	7	3	93	33	Poplar.
—	—	1	—	1	—	1	—	—	—	1	—	1	—	11	2	St. Saviour, Southwark.
—	—	2	1	4	—	1	—	1	—	—	1	2	1	21	5	St. George, Southwark.
5	—	—	1	—	—	2	—	1	—	2	—	1	—	36	11	Newington.
—	—	—	—	—	—	2	—	—	—	—	—	—	—	3	—	St. Olave, Southwark.
2	1	2	—	—	—	—	—	3	—	2	1	1	—	21	2	Bermondsey.
—	—	1	—	1	—	3	1	4	1	2	—	—	1	23	3	Rotherhithe.
6	—	2	1	6	1	5	1	3	—	9	3	4	1	89	18	Lambeth.
9	2	6	2	6	1	8	3	5	2	6	—	4	2	89	23	Battersea.
4	3	2	—	2	—	5	2	9	—	5	1	7	—	52	11	Wandsworth.
12	3	10	3	13	6	16	3	17	6	11	1	8	3	143	42	Camberwell.
8	3	13	2	6	3	10	4	15	4	15	3	13	6	130	38	Greenwich.
1	—	1	1	2	1	1	—	—	—	3	1	4	—	23	4	Lewisham.
—	—	1	—	—	1	1	—	—	—	—	—	—	—	9	3	Woolwich.
6	3	4	—	2	1	1	—	1	—	1	—	—	1	31	8	Plumstead.
—	—	2	—	2	—	1	—	1	—	1	—	—	—	11	1	Lee.
—	—	1	—	—	—	—	—	—	—	—	—	—	—	2	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96).   ‖ Including Tower of London (population, 868).

	Sanitary Areas.	Population (1891).	April 6. Cases.	April 6. Deaths.	April 13. Cases.	April 13. Deaths.	April 20. Cases.	April 20. Deaths.	April 27. Cases.	April 27. Deaths.	May 4. Cases.	May 4. Deaths.	May 11. Cases.	May 11. Deaths.
			DIPHTHERIA—*continued.* Weekly Statement, 2nd Quarter, 1895.											
	London	4,232,118	[a]157	22	140	26	134	30	152	27	159	29	153	38
	(*Administrative County*)	-	[b]*151*	—	*129*	—	*128*	—	*145*	—	*155*	—	*145*	—
W. District.	Kensington	166,308	11	—	6	2	3	5	6	—	4	1	6	—
	Fulham	91,639	7	1	6	1	5	—	6	—	1	—	5	1
	Hammersmith	97,239	—	—	2	2	3	—	6	—	5	—	9	—
	Paddington	117,846	9	—	1	1	1	—	3	—	7	—	4	2
	Chelsea	96,253	3	—	2	1	12	1	6	—	5	—	1	1
	St. George, Hanover Sq.*	78,599	2	1	—	—	4	1	2	—	3	2	2	3
	Westminster	55,539	2	2	—	—	3	—	4	—	2	1	2	—
	St. James, Westminster	24,995	2	—	—	—	—	—	—	—	3	—	—	—
N. District.	St. Marylebone	142,404	—	—	8	—	4	1	4	1	6	—	2	—
	Hampstead	68,416	2	—	2	1	1	—	2	—	3	1	—	—
	St. Pancras	234,379	10	1	3	—	6	1	8	3	6	1	2	2
	Islington	319,143	13	3	5	1	5	—	4	1	8	1	7	2
	St. Mary, Stoke Newington	30,936	—	—	1	—	1	—	—	—	1	—	1	—
	Hackney	198,606	4	1	6	1	5	1	4	—	13	—	8	1
Central District.	St. Giles and St. George, Bloomsbury.	39,782	1	1	—	—	2	1	2	1	1	—	1	—
	St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	—	—	—	—	—	—
	Strand†	25,217	2	—	1	1	2	—	1	1	—	1	—	—
	Holborn‡	34,043	—	—	—	—	2	—	—	—	1	1	—	—
	Clerkenwell	66,216	1	—	5	1	2	1	2	—	—	—	3	—
	St. Luke, Middlesex	42,440	—	1	—	—	1	—	1	—	—	—	—	1
	London, City of §	37,583	—	—	1	—	2	—	—	—	1	—	—	—
E. District.	Shoreditch	124,009	7	3	2	1	3	—	6	1	5	1	7	—
	Bethnal Green	129,132	5	—	2	1	3	1	3	—	8	1	8	3
	Whitechapel‖	74,420	5	1	8	—	5	—	4	1	7	1	5	3
	St. George-in-the-East	45,795	1	—	2	—	1	1	—	—	4	—	2	1
	Limehouse	57,376	4	—	1	—	4	—	2	1	3	2	2	2
	Mile End Old Town	107,592	3	1	10	—	2	1	6	—	4	2	9	1
	Poplar	166,748	15	1	7	3	3	2	13	2	15	1	12	4
S. District.	St. Saviour, Southwark	27,177	—	1	—	—	—	—	—	—	3	—	1	—
	St. George, Southwark	59,712	2	—	—	—	1	—	2	1	1	—	—	—
	Newington	115,804	2	—	1	—	4	2	4	—	—	2	1	1
	St. Olave, Southwark	12,723	—	—	—	—	—	—	1	—	—	—	—	—
	Bermondsey	84,682	3	—	3	—	2	1	—	—	1	—	—	—
	Rotherhithe	39,255	2	1	1	1	—	—	5	—	1	2	3	1
	Lambeth	275,203	4	—	12	—	7	—	5	1	13	—	6	2
	Battersea	150,558	7	1	7	3	8	3	10	2	6	1	3	1
	Wandsworth	156,942	4	—	2	—	4	1	6	3	2	1	4	2
	Camberwell	235,344	10	1	23	3	13	3	14	6	9	2	26	3
	Greenwich	165,413	11	—	3	2	9	2	6	1	3	2	9	—
	Lewisham	92,647	—	—	1	—	—	—	1	—	—	—	1	—
	Woolwich	40,848	1	1	1	—	—	—	3	1	2	1	—	—
	Plumstead	52,436	2	—	4	—	1	1	—	—	3	1	1	1
	Lee	36,103	—	—	1	—	—	—	—	—	—	—	—	—
	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications*.

[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.

* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

Diphtheria—*continued.*																
Weekly Statement, 2nd Quarter, 1895—*continued.*														Totals for 2nd Quarter, 1895.		Sanitary Areas.
May 18.		May 25.		June 1.		June 8.		June 15.		June 22.		June 29.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
174	40	171	37	174	39	175	32	199	45	216	36	255	38	2,259	439	London.
157	—	*166*	—	*163*	—	*164*	—	*192*	—	*205*	—	*241*	—	*2,141*	—	(*Administrative County.*)
4	—	4	1	8	4	4	1	6	1	7	1	4	1	73	17	Kensington.
3	1	1	1	4	—	3	—	6	5	7	3	17	2	73	15	Fulham.
2	—	1	—	4	—	5	—	1	1	5	—	3	2	46	5	Hammersmith.
7	—	11	—	4	2	6	3	1	—	7	—	7	—	68	8	Paddington.
3	1	8	1	5	1	3	—	4	1	8	1	3	2	63	10	Chelsea.
1	—	1	—	2	—	4	—	2	—	1	—	1	—	25	7	St. George, Hanover Sq.*
1	1	2	1	—	—	2	—	3	—	2	—	2	—	25	5	Westminster.
2	—	1	—	—	—	—	—	—	—	—	—	1	—	9	—	St. James, Westminster.
1	1	1	1	2	—	2	—	6	—	2	—	9	1	47	5	St. Marylebone.
1	—	3	—	2	1	2	—	—	—	2	—	4	—	24	3	Hampstead.
12	—	8	3	4	1	8	1	6	2	7	1	19	2	99	18	St. Pancras.
8	4	8	1	9	1	6	3	6	—	17	—	5	1	101	18	Islington.
2	—	2	1	1	—	1	—	1	—	1	—	3	—	15	1	St. Mary, Stoke Newington.
9	2	9	—	4	1	5	3	6	2	9	—	8	1	89	13	Hackney.
—	—	3	1	4	—	2	1	—	—	2	—	2	1	20	6	St. Giles and St. George, Bloomsbury.
—	—	—	—	2	—	2	—	—	1	—	—	—	—	4	1	St. Martin-in-the-Fields.
1	—	—	—	2	—	—	—	—	—	—	—	1	—	10	3	Strand.†
—	—	—	—	2	1	2	—	—	—	1	—	—	1	8	3	Holborn.‡
1	1	6	—	3	1	—	—	—	1	6	—	—	—	29	5	Clerkenwell.
—	—	1	1	3	—	2	—	2	1	3	1	2	—	15	5	St. Luke, Middlesex.
1	2	1	—	—	—	2	—	3	—	—	1	—	—	11	3	London, City of.§
2	1	5	—	10	2	3	3	6	—	10	3	3	—	69	15	Shoreditch.
4	2	3	—	6	2	3	2	10	2	4	1	13	4	72	19	Bethnal Green.
8	1	7	1	6	1	9	2	—	1	5	—	7	2	76	14	Whitechapel.‖
9	—	4	—	7	2	2	3	4	1	2	1	2	—	40	9	St. George-in-the-East.
8	2	3	1	2	1	1	—	1	2	4	1	—	—	35	12	Limehouse.
5	2	10	2	3	1	5	1	12	2	5	4	20	1	94	18	Mile End Old Town.
6	2	14	3	12	3	20	2	23	4	16	2	24	4	180	33	Poplar.
—	—	1	—	—	—	—	—	4	—	1	1	1	1	11	3	St. Saviour, Southwark.
—	—	—	—	—	—	1	—	4	—	3	—	2	—	16	1	St. George, Southwark.
9	2	1	1	6	1	7	1	8	—	7	1	12	1	62	12	Newington.
—	—	1	—	—	—	—	—	—	—	—	—	—	—	2	—	St. Olave, Southwark.
2	—	4	1	6	1	—	—	8	1	7	3	1	2	37	9	Bermondsey.
11	2	4	5	4	1	8	—	1	3	5	—	8	1	53	17	Rotherhithe.
10	2	6	2	11	1	10	2	19	5	17	2	17	3	137	20	Lambeth.
2	—	4	1	2	1	4	1	10	2	12	3	10	—	85	19	Battersea.
7	—	2	1	5	—	1	—	5	1	5	1	10	2	57	12	Wandsworth.
14	8	14	2	16	3	24	2	16	4	9	2	18	2	206	41	Camberwell.
10	2	13	5	6	5	8	1	9	2	15	3	10	1	112	26	Greenwich.
1	—	1	—	1	—	4	—	2	—	—	—	2	—	14	—	Lewisham.
3	—	1	—	—	—	1	—	2	—	—	—	1	—	15	3	Woolwich.
2	1	2	—	5	1	3	—	2	—	2	—	1	—	28	5	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	2	—	3	—	Lee.
—	—	—	—	1	—	—	—	—	—	—	—	—	—	1	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

Sanitary Areas.		Population (1891).	Diphtheria—*continued.* Weekly Statement, 3rd Quarter, 1895. July 6. Cases.	July 6. Deaths.	July 13. Cases.	July 13. Deaths.	July 20. Cases.	July 20. Deaths.	July 27. Cases.	July 27. Deaths.	Aug. 3. Cases.	Aug. 3. Deaths.	Aug. 10. Cases.	Aug. 10. Deaths.
London		4,232,118	[a]273	52	305	48	283	39	306	46	274	57	236	54
(*Administrative County*)		-	[b]*261*	—	*279*	—	*267*	—	*292*	—	*246*	—	*213*	—
W. District.	Kensington	166,208	3	2	16	2	13	2	16	2	10	4	12	1
	Fulham	91,639	9	—	9	6	18	—	7	1	7	2	2	1
	Hammersmith	97,239	11	4	6	2	4	—	10	—	4	1	7	1
	Paddington	117,846	11	—	9	—	4	2	9	1	6	2	4	1
	Chelsea	96,253	7	2	16	—	11	1	8	—	6	4	4	—
	St George, Hanover Sq.*	78,599	1	—	4	1	4	1	3	—	3	1	2	—
	Westminster	55,539	2	—	—	—	3	1	2	—	2	—	—	—
	St. James, Westminster	24,995	—	—	1	—	1	—	2	—	—	—	3	—
N. District.	St. Marylebone	142,404	4	—	8	2	7	1	7	2	3	—	5	1
	Hampstead	68,416	5	1	1	—	4	—	1	—	3	—	5	1
	St. Pancras	234,379	14	1	17	1	10	4	13	1	13	—	9	5
	Islington	319,143	3	2	6	1	12	—	15	3	14	4	10	4
	St. Mary, Stoke Newington	30,936	1	1	4	—	—	—	—	—	—	—	—	—
	Hackney	198,606	5	1	6	—	4	—	9	1	10	1	9	1
Central District.	St. Giles and St. George, Bloomsbury.	39,782	3	—	3	1	—	—	—	—	—	—	—	—
	St. Martin-in-the-Fields	14,616	—	—	2	—	1	—	—	—	1	—	—	—
	Strand†	25,217	—	1	—	—	—	—	—	—	—	—	—	—
	Holborn‡	34,043	2	—	1	—	—	—	2	1	8	—	—	—
	Clerkenwell	66,216	3	—	2	—	4	1	6	—	1	1	1	1
	St. Luke, Middlesex	42,440	4	1	5	3	1	1	4	—	—	—	4	—
	London, City of§	37,583	3	—	—	—	1	—	1	—	5	—	2	—
E. District.	Shoreditch	124,009	7	1	7	1	5	1	8	2	6	1	5	2
	Bethnal Green	129,132	21	4	22	2	16	4	12	—	7	5	4	3
	Whitechapel‖	74,420	8	—	10	1	6	1	14	2	12	3	8	3
	St. George-in-the-East	45,795	6	—	7	—	13	1	9	—	6	3	16	3
	Limehouse	57,376	2	1	11	1	8	1	4	1	3	1	4	—
	Mile End Old Town	107,592	9	5	14	4	15	1	16	3	16	2	19	4
	Poplar	166,748	13	3	14	4	16	1	16	4	21	2	15	7
S. District.	St. Saviour, Southwark	27,177	—	—	1	—	2	—	2	—	1	1	—	—
	St. George, Southwark	59,712	4	—	2	—	—	—	2	1	1	—	2	—
	Newington	115,804	14	4	4	1	11	—	9	—	8	1	7	1
	St. Olave, Southwark	12,723	—	—	—	—	2	—	—	—	3	1	—	—
	Bermondsey	84,682	2	—	2	—	1	—	6	2	5	1	1	1
	Rotherhithe	39,255	2	2	1	—	6	1	11	—	3	—	1	1
	Lambeth	275,203	21	2	25	4	19	4	30	4	18	3	26	2
	Battersea	150,558	11	2	8	1	1	1	5	—	7	1	4	2
	Wandsworth	156,942	10	1	7	3	11	1	7	1	6	—	7	1
	Camberwell	235,344	19	4	18	6	20	5	18	7	26	6	17	1
	Greenwich	165,413	21	6	28	—	27	2	17	6	23	5	18	5
	Lewisham	92,647	4	—	3	1	2	—	—	—	2	—	1	—
	Woolwich	40,848	3	1	4	—	—	1	3	—	2	1	2	1
	Plumstead	52,436	3	—	1	—	—	—	2	1	2	—	—	—
	Lee	36,103	—	—	—	—	—	—	—	—	—	—	—	—
	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications*.
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

DIPHTHERIA—*continued.*

Aug. 17. Cases.	Aug. 17. Deaths.	Aug. 24. Cases.	Aug. 24. Deaths.	Aug. 31. Cases.	Aug. 31. Deaths.	Sept. 7. Cases.	Sept. 7. Deaths.	Sept. 14. Cases.	Sept. 14. Deaths.	Sept. 21. Cases.	Sept. 21. Deaths.	Sept. 28. Cases.	Sept. 28. Deaths.	Totals for 3rd Quarter, 1895. Cases.	Totals for 3rd Quarter, 1895. Deaths.	Sanitary Areas.
																Weekly Statement, 3rd Quarter, 1895—*continued.*
182	50	202	24	195	39	232	37	280	55	278	37	305	56	3,351	594	London.
173	—	*195*	—	*185*	—	*218*	—	*252*	—	*265*	—	*290*	—	*3,136*	—	(*Administrative County.*)
4	4	4	1	8	—	9	2	8	1	8	2	13	1	126	24	Kensington.
—	—	14	1	6	—	4	1	9	2	4	1	10	3	99	18	Fulham.
1	—	1	—	—	1	—	—	4	2	5	1	4	—	57	12	Hammersmith.
6	4	1	1	4	3	5	—	5	—	6	2	10	1	80	17	Paddington.
1	1	5	—	8	—	3	—	6	1	3	—	4	1	82	10	Chelsea.
—	—	—	—	—	—	—	—	4	—	6	—	6	1	33	4	St. George, Hanover Sq.*
5	—	—	—	—	—	2	—	1	—	2	—	2	—	21	1	Westminster.
1	—	2	—	1	—	4	1	—	—	—	—	—	—	15	1	St. James, Westminster.
4	2	3	—	7	—	8	—	9	—	6	1	11	—	82	9	St. Marylebone.
—	—	—	—	5	—	1	—	3	—	—	—	3	—	31	2	Hampstead.
6	—	6	2	8	3	11	3	19	3	31	4	29	5	186	32	St. Pancras.
8	6	6	2	9	2	13	1	22	2	12	2	12	5	142	34	Islington.
2	1	1	—	—	—	2	—	3	1	1	—	—	—	14	3	St. Mary, Stoke Newington.
3	—	4	—	4	1	12	1	11	4	20	2	18	1	115	13	Hackney.
1	1	2	—	—	—	—	1	1	—	4	—	1	—	15	3	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	1	—	—	—	—	—	—	—	5	—	St. Martin-in-the-Fields.
1	—	1	—	—	—	2	—	1	1	—	—	1	—	6	2	Strand.†
—	—	—	—	4	—	1	—	2	—	3	—	2	—	25	1	Holborn.‡
—	—	4	—	1	—	5	1	3	1	2	2	4	—	36	7	Clerkenwell.
1	—	2	—	2	—	1	—	2	2	7	—	1	—	34	7	St. Luke, Middlesex.
1	—	1	—	1	—	1	1	1	—	—	—	—	—	17	1	London, City of.§
3	1	7	1	7	4	7	—	7	2	3	—	8	1	80	17	Shoreditch.
5	3	15	2	11	3	19	1	11	3	15	1	13	5	171	36	Bethnal Green.
10	3	7	2	5	2	9	1	3	2	4	1	5	—	101	21	Whitechapel.‖
10	3	6	2	6	—	4	4	8	—	12	1	8	4	111	21	St. George-in-the-East.
5	2	2	—	6	1	6	—	9	2	4	—	2	—	66	10	Limehouse.
9	3	13	—	6	4	16	3	18	5	16	3	9	3	176	40	Mile End Old Town.
23	6	20	2	11	3	12	—	19	5	18	1	16	3	214	41	Poplar.
1	—	2	—	1	—	1	—	6	—	2	1	4	1	23	3	St. Saviour, Southwark
4	1	1	—	3	—	5	2	5	1	2	—	6	2	37	7	St. George, Southwark
5	3	13	1	4	—	3	—	5	1	5	—	5	—	93	12	Newington.
—	—	—	—	1	—	—	—	—	—	1	—	2	—	9	1	St. Olave, Southwark.
1	—	—	—	5	—	3	3	3	—	2	—	2	—	33	7	Bermondsey.
3	—	4	—	2	1	—	1	1	—	3	—	9	—	46	6	Rotherhithe.
15	1	9	1	11	1	19	4	18	4	14	3	17	5	242	38	Lambeth.
7	1	4	2	2	2	5	1	3	1	5	1	9	1	71	16	Battersea.
3	—	7	—	4	—	1	—	4	—	1	—	5	—	73	7	Wandsworth.
14	2	19	1	28	4	15	3	21	3	21	2	23	7	259	51	Camberwell.
17	2	11	2	9	4	17	2	23	5	25	4	24	4	259	47	Greenwich.
1	—	2	—	3	—	1	—	2	—	2	—	3	—	26	1	Lewisham.
1	—	1	1	1	—	—	—	—	—	—	—	1	1	18	6	Woolwich.
—	—	2	—	—	—	3	—	1	1	2	1	3	1	19	4	Plumstead.
—	—	—	—	1	—	1	—	—	—	1	1	—	—	3	1	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

Sanitary Areas.		Population (1891).	DIPHTHERIA—*continued.* Weekly Statement, 4th Quarter, 1893. Oct. 5. Cases.	Oct. 5. Deaths.	Oct. 12. Cases.	Oct. 12. Deaths.	Oct. 19. Cases.	Oct. 19. Deaths.	Oct. 26. Cases.	Oct. 26. Deaths.	Nov. 2. Cases.	Nov. 2. Deaths.	Nov. 9. Cases.	Nov. 9. Deaths.	Nov. 16. Cases.	Nov. 16. Deaths.
London		4,232,118	a315	44	345	56	327	75	334	60	304	72	376	74	300	60
(*Administrative County*)			b*293*	—	*324*	—	*310*	—	*319*	—	*290*	—	*353*	—	*285*	—
W. District.	Kensington	166,208	15	3	9	—	20	6	12	—	8	5	6	6	11	4
	Fulham	91,639	4	—	13	1	9	4	17	2	8	2	19	3	9	1
	Hammersmith	97,239	10	2	1	—	1	1	10	4	4	4	3	1	3	1
	Paddington	117,846	4	—	3	1	5	—	12	2	5	1	13	2	11	1
	Chelsea	96,253	8	—	9	1	9	1	12	1	14	4	18	6	7	3
	St. George, Hanover Sq.*	78,599	3	2	2	1	2	—	—	—	4	1	4	2	2	—
	Westminster	55,539	3	—	2	—	—	1	3	—	2	—	4	3	7	1
	St. James, Westminster	24,995	—	—	3	—	—	—	—	1	—	—	—	—	1	—
N. District.	St. Marylebone	142,404	5	1	19	1	8	5	4	1	5	—	3	1	2	2
	Hampstead	68,416	4	—	1	—	2	—	5	—	7	3	4	—	7	1
	St. Pancras	234,379	21	5	19	7	20	5	15	7	10	2	15	6	24	7
	Islington	319,143	14	1	23	6	18	3	33	6	17	7	28	7	10	3
	St. Mary, Stoke Newington	30,936	1	—	3	—	2	—	1	—	1	—	—	—	4	—
	Hackney	198,606	19	4	27	4	20	—	10	3	19	—	11	3	16	3
Central District.	St. Giles and St. George, Bloomsbury.	39,782	1	—	1	—	2	1	2	1	1	—	5	—	2	—
	St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Strand†	25,217	—	—	2	1	—	—	3	—	5	1	—	—	2	—
	Holborn‡	34,043	3	—	2	1	1	—	2	—	1	—	1	—	—	—
	Clerkenwell	66,216	1	—	10	2	8	2	4	—	3	1	4	1	3	1
	St. Luke, Middlesex	42,440	3	—	6	1	2	1	1	—	1	1	5	1	1	—
	London, City of§	37,583	—	—	1	—	1	1	1	—	—	—	2	—	3	—
E. District.	Shoreditch	124,009	8	2	8	1	6	4	3	2	3	2	7	1	3	—
	Bethnal Green	129,132	33	3	10	2	10	2	20	2	7	3	13	2	10	1
	Whitechapel‖	74,420	7	1	9	2	5	1	3	—	17	1	12	1	5	—
	St. George-in-the-East	45,795	7	2	6	2	3	2	4	—	8	3	4	—	3	—
	Limehouse	57,376	6	3	11	1	7	2	5	2	5	1	7	—	3	—
	Mile End Old Town	107,592	8	—	14	—	16	5	19	1	9	4	9	—	19	7
	Poplar	166,748	18	3	13	2	16	3	13	6	20	1	32	3	23	2
S. District.	St. Saviour, Southwark	27,177	—	—	2	—	5	—	3	1	3	1	—	1	—	—
	St. George, Southwark	59,712	1	1	6	—	4	—	—	—	—	—	7	—	2	—
	Newington	115,804	10	1	6	2	7	1	3	1	5	—	21	2	6	2
	St. Olave, Southwark	12,723	1	—	2	1	1	—	1	—	2	1	1	—	—	—
	Bermondsey	84,682	2	—	—	—	8	1	5	2	2	—	—	—	3	—
	Rotherhithe	39,255	1	1	3	—	2	1	2	1	1	1	1	—	1	1
	Lambeth	275,203	13	1	13	3	6	3	17	2	19	2	21	3	12	1
	Battersea	150,558	8	1	6	—	14	4	7	2	14	5	16	3	19	2
	Wandsworth	156,942	2	1	7	1	8	2	10	1	6	1	7	3	11	1
	Camberwell	235,344	19	1	25	1	31	6	23	1	24	3	33	4	21	7
	Greenwich	165,413	43	3	36	7	35	5	40	6	35	9	25	6	19	4
	Lewisham	92,647	5	1	7	2	7	—	2	—	—	—	2	—	5	2
	Woolwich	40,848	—	—	1	—	3	—	—	—	2	—	2	—	5	—
	Plumstead	52,436	4	1	4	2	3	2	6	1	4	1	6	3	2	—
	Lee	36,103	—	—	—	—	—	—	1	1	3	1	5	—	3	2
	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

a Totals of actual *notifications.*
b Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

Nov. 23. Cases.	Nov. 23. Deaths.	Nov. 30. Cases.	Nov. 30. Deaths.	Dec. 7. Cases.	Dec. 7. Deaths.	Dec. 14. Cases.	Dec. 14. Deaths.	Dec. 21. Cases.	Dec. 21. Deaths.	Dec. 28. Cases.	Dec. 28. Deaths.	Totals for 4th Quarter, 1895. Cases.	Totals for 4th Quarter, 1895. Deaths.	Grand Totals for Year 1895. Cases.	Grand Totals for Year 1895. Deaths.	Sanitary Areas.
																Diphtheria—continued. Weekly Statement, 4th Quarter, 1895—*continued.*
312	69	286	62	309	69	292	62	279	62	258	71	4,037	836	11,447	2,289	London.
292	—	*258*	—	*286*	—	*274*	—	*260*	—	*233*	—	*3,797*	—	*10,807*	—	(*Administrative County.*)
7	5	7	2	7	—	6	1	11	4	9	2	128	38	383	90	Kensington.
9	1	18	6	10	3	7	2	10	2	20	3	153	30	389	77	Fulham.
8	1	3	1	2	—	9	2	3	1	2	—	59	18	204	44	Hammersmith.
6	4	3	1	4	1	3	—	2	—	4	1	75	14	246	47	Paddington.
15	1	5	3	10	2	5	—	12	1	14	6	138	29	325	57	Chelsea.
1	1	1	—	1	—	4	—	3	1	5	2	32	10	114	24	St. George, Hanover Sq.*
3	1	—	—	3	1	3	1	3	—	3	2	36	10	112	21	Westminster.
1	—	4	1	2	—	2	—	—	—	2	—	15	2	49	4	St. James, Westminster.
4	—	3	—	9	1	5	2	4	1	7	2	73	17	252	35	St. Marylebone.
5	1	5	—	1	—	2	—	1	—	2	2	46	7	119	14	Hampstead.
10	6	9	5	11	2	10	4	16	2	6	1	186	59	582	131	St. Pancras.
15	4	17	3	21	5	25	9	18	8	19	5	258	67	612	146	Islington.
2	—	1	—	1	—	3	—	—	—	2	—	21	—	61	5	St. Mary, Stoke Newington.
17	2	26	3	17	5	24	5	13	4	14	4	233	40	520	83	Hackney.
2	—	2	—	2	—	1	—	—	1	2	—	23	3	66	13	St. Giles and St. George, Bloomsbury.
2	1	6	1	—	—	—	—	—	—	—	—	8	2	23	7	St. Martin-in the-Fields.
—	—	2	—	—	2	1	—	--	—	—	—	15	4	39	13	Strand.†
1	—	—	—	—	—	2	—	—	—	3	1	16	2	58	7	Holborn.‡
5	—	6	—	7	4	3	2	2	1	4	2	60	16	142	34	Clerkenwell.
2	—	1	—	3	—	4	—	3	—	2	1	34	5	105	20	St. Luke, Middlesex.
—	—	3	—	1	—	2	—	1	1	—	—	15	2	50	8	London, City of.§
12	2	3	—	6	1	6	—	7	2	5	2	77	19	260	58	Shoreditch.
7	3	16	6	9	3	11	3	13	—	6	2	165	32	471	101	Bethnal Green.
5	1	2	—	11	1	5	1	6	4	10	5	97	18	316	58	Whitechapel.‖
4	—	5	4	11	2	8	—	4	—	4	—	71	15	249	50	St. George-in-the-East.
7	—	5	2	4	1	—	1	1	—	2	—	63	13	198	45	Limehouse.
20	1	10	—	17	3	18	1	13	7	12	2	184	31	513	111	Mile End Old Town.
23	9	18	3	23	2	24	4	27	4	13	3	263	45	750	152	Poplar.
2	—	4	—	—	1	2	—	1	1	—	—	22	5	67	13	St. Saviour, Southwark.
3	—	2	—	2	—	1	1	4	—	—	2	32	4	106	17	St. George, Southwark.
10	3	6	2	3	—	4	1	6	—	3	2	90	17	281	52	Newington.
—	—	1	—	—	1	—	—	—	—	—	—	9	3	23	4	St. Olave, Southwark.
1	2	2	2	2	2	2	1	1	1	—	—	28	11	119	20	Bermondsey.
—	—	2	—	1	—	3	—	1	—	—	—	18	5	142	31	Rotherhithe.
25	3	22	6	22	7	8	2	13	2	17	1	208	36	676	112	Lambeth.
17	4	5	2	11	2	1	2	8	4	17	3	143	34	388	92	Battersea.
7	1	6	—	4	3	12	2	8	—	2	—	90	16	272	46	Wandsworth.
15	3	16	2	19	4	23	4	31	2	19	7	299	45	912	179	Camberwell.
31	5	30	5	28	8	27	7	16	4	11	4	376	73	877	184	Greenwich.
4	—	6	—	15	1	4	2	1	1	2	—	60	9	123	14	Lewisham.
1	1	—	—	3	—	1	—	4	1	1	—	23	2	65	14	Woolwich.
2	2	1	—	2	—	7	2	8	1	11	4	60	19	138	38	Plumstead.
1	1	2	2	4	1	4	—	4	1	3	—	30	9	47	11	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

District	Sanitary Areas.	Population (1891).	Enteric Fever. Weekly Statement, 1st Quarter, 1895. Jan. 5. Cases.	Jan. 5. Deaths.	Jan. 12. Cases.	Jan. 12. Deaths.	Jan. 19. Cases.	Jan. 19. Deaths.	Jan. 26. Cases.	Jan. 26. Deaths.	Feb. 2. Cases.	Feb. 2. Deaths.	Feb. 9. Cases.	Feb. 9. Deaths.
	London	4,232,118	[a]109	16	75	16	102	20	100	15	67	9	42	12
	(*Administrative County*)	-	[b]*400*	—	*76*	—	*96*	—	*97*	—	*60*	—	*40*	—
W. District.	Kensington	166,308	3	1	1	—	12	1	4	1	4	—	—	1
W. District.	Fulham	91,639	2	1	1	—	—	—	1	—	—	1	1	—
W. District.	Hammersmith	97,239	3	—	1	—	1	—	2	2	1	—	—	—
W. District.	Paddington	117,846	2	—	1	1	—	—	5	—	2	—	1	—
W. District.	Chelsea	96,253	2	—	2	—	6	—	2	1	1	1	—	—
W. District.	St. George, Hanover Sq.*	78,599	1	—	—	1	1	—	2	—	1	—	1	—
W. District.	Westminster	55,539	—	—	2	—	2	—	1	—	2	—	—	—
W. District.	St. James, Westminster	24,995	—	—	—	—	—	—	—	—	1	—	—	—
N. District.	St. Marylebone	142,404	3	—	5	—	4	3	6	—	1	1	1	—
N. District.	Hampstead	68,416	2	—	3	—	3	1	4	—	—	—	1	2
N. District.	St. Pancras	234,379	6	3	4	2	5	—	2	—	3	—	2	1
N. District.	Islington	319,143	5	1	6	1	9	3	5	—	1	—	2	—
N. District.	St. Mary, Stoke Newington	30,936	1	—	1	1	2	—	1	—	1	—	—	2
N. District.	Hackney	198,606	8	1	4	—	5	2	6	1	3	—	2	1
Central District.	St. Giles and St. George, Bloomsbury.	39,782	1	—	1	—	3	—	—	—	—	—	1	—
Central District.	St. Martin-in-the-Fields	14,616	—	—	1	—	—	—	1	—	—	—	1	—
Central District.	Strand†	25,217	—	—	2	—	1	1	3	1	—	—	—	1
Central District.	Holborn‡	34,043	—	—	—	—	—	—	1	—	—	—	—	—
Central District.	Clerkenwell	66,216	2	—	—	—	1	—	1	1	—	—	1	—
Central District.	St. Luke, Middlesex	42,440	3	—	—	—	1	—	—	—	—	—	1	1
Central District.	London, City of§	37,583	1	—	1	1	2	1	—	1	3	—	1	2
E. District.	Shoreditch	124,009	5	—	1	1	3	—	1	2	—	—	1	—
E. District.	Bethnal Green	129,132	3	—	2	—	1	—	2	—	5	1	—	—
E. District.	Whitechapel‖	74,420	1	—	1	1	—	—	—	1	—	—	1	—
E. District.	St. George-in-the-East	45,795	1	—	—	—	—	—	—	—	—	—	—	—
E. District.	Limehouse	57,376	3	1	—	—	—	—	1	—	—	—	1	—
E. District.	Mile End Old Town	107,592	1	—	3	—	—	—	2	—	1	—	—	—
E. District.	Poplar	166,748	2	2	3	—	—	—	—	—	1	1	3	—
S. District.	St. Saviour, Southwark	27,177	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. George, Southwark	59,712	—	—	1	—	2	1	1	—	6	—	—	—
S. District.	Newington	115,804	2	—	6	1	5	1	2	—	1	—	2	—
S. District.	St. Olave, Southwark	12,723	1	—	—	—	—	—	—	—	—	1	—	—
S. District.	Bermondsey	84,682	3	—	—	1	—	—	4	—	3	—	3	—
S. District.	Rotherhithe	39,255	7	1	1	—	1	—	4	1	—	—	1	1
S. District.	Lambeth	275,203	8	2	8	—	6	1	9	1	8	—	2	—
S. District.	Battersea	150,558	6	2	1	—	4	—	6	—	11	1	6	—
S. District.	Wandsworth	156,942	4	1	4	3	5	1	12	1	2	—	4	—
S. District.	Camberwell	235,344	6	—	3	1	8	1	9	1	4	2	2	—
S. District.	Greenwich	165,413	5	—	2	—	2	2	1	—	—	—	—	—
S. District.	Lewisham	92,647	3	—	2	1	3	1	—	—	—	—	—	—
S. District.	Woolwich	40,848	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Plumstead	52,436	—	—	1	—	3	—	—	—	1	—	—	—
S. District.	Lee	36,103	3	—	—	—	1	—	—	—	—	—	—	—
S. District.	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications*.
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

ENTERIC FEVER—*continued.*

Weekly Statement, 1st Quarter, 1895—*continued.*														Totals for 1st Quarter, 1895.		Sanitary Areas.
Feb. 16.		Feb. 23.		March 2.		March 9.		March 16.		March 23		March 30.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
34	10	22	3	35	7	32	7	29	3	28	4	33	4	708	126	London.
30	—	*21*	—	*34*	—	*31*	—	*30*	—	*27*	—	*32*	—	*674*	—	(*Administrative County.*)
1	—	1	—	2	2	1	—	—	—	1	—	—	1	30	7	Kensington.
2	1	1	—	1	—	—	—	—	—	—	—	—	—	9	3	Fulham.
—	—	—	—	1	—	1	—	2	2	—	—	2	—	14	4	Hammersmith.
1	—	—	—	—	—	2	—	2	—	1	—	—	—	17	1	Paddington.
—	—	2	—	—	—	1	1	1	—	—	—	—	—	17	3	Chelsea.
1	—	—	—	—	—	—	—	—	—	—	—	1	—	8	1	St. George, Hanover Sq.*
3	—	—	—	—	—	1	—	1	—	—	—	—	—	12	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	St. James, Westminster.
1	1	1	—	2	—	—	—	3	—	2	1	—	—	29	6	St. Marylebone.
2	—	—	—	—	—	—	—	—	—	—	—	1	—	16	3	Hampstead.
3	—	—	1	1	—	2	—	1	—	1	—	1	—	31	7	St. Pancras.
1	2	2	—	—	1	2	1	1	—	1	—	2	—	37	9	Islington.
—	—	1	—	1	—	—	—	—	—	—	—	—	—	8	3	St. Mary, Stoke Newington.
—	1	—	—	1	—	2	—	—	—	1	—	1	—	33	6	Hackney.
—	—	—	—	—	—	1	—	—	—	—	—	—	—	7	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	1	—	—	—	6	3	Strand.†
1	—	—	—	1	—	—	—	1	—	—	—	—	—	4	—	Holborn.‡
2	—	—	—	—	—	—	—	—	—	2	1	3	—	12	2	Clerkenwell.
—	—	2	—	1	—	—	—	—	—	—	—	—	—	8	1	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	1	—	—	—	9	5	London, City of.§
—	1	—	—	2	—	—	—	—	—	—	—	—	—	13	4	Shoreditch.
—	—	—	—	3	1	—	—	2	—	1	—	—	—	19	2	Bethnal Green.
—	—	—	—	1	—	—	—	—	—	—	—	—	—	4	2	Whitechapel.‖
1	—	1	—	—	—	—	—	—	—	—	—	2	—	5	—	St. George-in-the-East.
—	—	—	—	—	—	1	1	2	—	—	—	—	—	8	2	Limehouse.
—	—	—	—	1	—	—	—	1	—	—	—	—	—	9	—	Mile End Old Town.
—	1	—	—	—	—	2	—	3	—	2	—	3	—	19	4	Poplar.
—	—	—	—	—	—	1	—	—	—	1	—	—	—	2	—	St. Saviour, Southwark.
—	—	1	—	—	—	—	—	—	—	2	—	—	—	13	1	St. George, Southwark.
2	—	1	—	2	—	3	1	—	—	—	—	—	—	26	3	Newington.
—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	2	St. Olave, Southwark.
2	1	1	—	—	—	—	1	—	—	1	—	1	—	18	3	Bermondsey.
—	—	—	—	—	—	—	—	1	—	—	—	—	—	15	3	Rotherhithe.
4	—	2	1	—	—	3	—	1	—	3	—	4	—	58	5	Lambeth.
2	—	1	1	3	1	1	1	—	—	—	—	3	—	44	6	Battersea.
2	—	2	—	1	—	3	—	2	—	—	—	3	2	44	8	Wandsworth.
—	1	—	—	10	1	5	1	4	1	6	—	1	—	58	9	Camberwell.
2	1	2	—	—	1	—	—	—	—	—	—	5	—	19	4	Greenwich.
—	—	1	—	—	—	—	—	—	—	1	—	—	—	10	2	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Woolwich.
—	—	—	—	1	—	—	—	—	—	—	—	—	1	6	1	Plumstead.
1	—	—	—	—	—	—	—	—	—	—	1	—	—	5	1	Lee.
—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

§ Including Inner Temple (population, 96).

‖ Including Tower of London (population, 868).

Sanitary Areas.		Population (1891).	Enteric Fever—*continued.* Weekly Statement, 2nd Quarter, 1895. April 6.		April 13.		April 20.		April 27.		May 4.		May 11.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
London		4,232,118	[a]26	6	26	3	32	5	31	5	37	5	43	8
(*Administrative County*)		-	[b]*25*	—	*27*	—	*28*	—	*28*	—	*37*	—	*41*	—
W. District.	Kensington	166,308	1	—	2	—	2	—	—	—	1	—	2	—
	Fulham	91,639	2	—	—	—	1	—	—	—	2	—	—	—
	Hammersmith	97,239	1	1	—	—	1	—	1	—	1	—	1	—
	Paddington	117,846	3	—	1	—	—	2	2	—	—	1	—	1
	Chelsea	96,253	—	—	—	—	—	—	—	—	1	—	2	—
	St. George, Hanover Sq.*	78,599	—	—	—	—	1	—	—	—	2	—	1	—
	Westminster	55,539	—	—	—	—	—	—	—	—	2	—	—	—
	St. James, Westminster	24,995	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	2	—	1	1	2	—	3	—	1	—	2	1
	Hampstead	68,416	—	—	—	—	—	—	1	—	1	—	1	1
	St. Pancras	234,379	1	—	—	—	—	—	1	—	—	—	3	—
	Islington	319,143	—	1	—	—	1	—	3	—	1	—	1	—
	St. Mary, Stoke Newington	30,936	—	—	—	—	1	—	—	—	1	—	—	—
	Hackney	198,606	2	—	2	—	—	—	4	—	3	—	3	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	1	—	—	—
	St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	—	—	—	—	—	—
	Strand†	25,217	—	—	—	—	—	—	—	—	1	—	—	—
	Holborn‡	34,043	—	—	1	—	—	—	—	—	—	—	—	—
	Clerkenwell	66,216	—	—	—	—	1	—	1	1	2	1	1	—
	St. Luke, Middlesex	42,440	—	—	2	—	—	1	—	—	1	—	—	—
	London, City of §	37,583	1	1	1	—	—	—	—	—	—	—	—	1
E. District.	Shoreditch	124,009	—	—	—	—	—	—	—	—	1	—	—	—
	Bethnal Green	129,132	—	—	3	—	2	—	—	—	1	—	—	—
	Whitechapel‖	74,420	—	—	—	—	—	—	—	—	—	—	1	—
	St. George-in-the-East	45,795	1	—	—	—	2	1	2	—	—	1	1	1
	Limehouse	57,376	1	—	—	—	—	—	—	—	2	—	2	—
	Mile End Old Town	107,592	—	—	1	—	—	1	—	—	2	—	—	—
	Poplar	166,748	1	2	2	1	3	—	1	—	—	—	1	—
S. District.	St. Saviour, Southwark	27,177	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Southwark	59,712	—	—	1	—	—	—	—	—	2	—	1	—
	Newington	115,804	2	—	—	—	2	—	—	—	1	—	1	2
	St. Olave, Southwark	12,723	—	—	—	—	—	—	—	—	—	—	—	—
	Bermondsey	84,682	1	1	3	—	—	—	—	—	1	—	1	—
	Rotherhithe	39,255	—	—	1	—	—	—	—	—	—	1	1	—
	Lambeth	275,203	1	—	1	1	3	—	3	—	3	—	7	—
	Battersea	150,558	—	—	—	—	—	—	4	1	—	—	1	—
	Wandsworth	156,942	3	—	—	—	4	—	1	—	1	1	3	1
	Camberwell	235,344	2	—	1	—	2	—	—	1	1	—	1	—
	Greenwich	165,413	1	—	3	—	4	—	3	1	1	—	2	—
	Lewisham	92,647	—	—	—	—	—	—	1	1	—	—	—	—
	Woolwich	40,848	—	—	—	—	—	—	—	—	—	—	—	—
	Plumstead	52,436	—	—	—	—	—	—	—	—	—	—	3	—
	Lee	36,103	—	—	—	—	—	—	—	—	—	—	—	—
	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications.*
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

ENTERIC FEVER—*continued.*

Weekly Statement, 2nd Quarter, 1895—*continued.*

May 18.		May 25.		June 1.		June 8.		June 15.		June 22.		June 29.		Totals for 2nd Quarter, 1895.		Sanitary Areas.
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
80	8	82	9	71	5	53	8	38	5	46	4	40	7	605	78	London.
80	—	*81*	—	*71*	—	*50*	—	*36*	—	*46*	—	*40*	—	*590*	—	(*Administrative County.*)
—	—	1	—	—	—	2	—	—	—	—	—	—	—	11	—	Kensington.
1	1	—	—	—	—	—	—	—	—	—	—	1	—	7	1	Fulham.
—	—	—	—	—	—	—	—	3	—	—	—	—	1	8	2	Hammersmith.
—	—	1	—	3	1	1	—	1	—	—	—	1	—	13	5	Paddington.
—	—	—	—	—	—	—	—	—	—	—	—	2	—	5	—	Chelsea.
2	—	2	—	—	—	—	—	1	—	—	—	—	—	9	—	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	1	—	3	—	Westminster.
—	—	—	—	1	—	—	—	—	—	—	—	—	—	1	—	St. James, Westminster.
1	—	1	1	—	—	3	—	1	—	2	—	5	1	24	4	St. Marylebone.
—	—	1	—	—	—	1	—	—	1	—	—	2	—	7	2	Hampstead.
1	1	2	—	1	—	1	—	3	—	4	—	3	1	20	2	St. Pancras.
—	—	—	—	—	—	1	—	—	—	3	—	—	—	10	1	Islington.
1	—	—	—	—	—	2	—	—	—	1	—	—	—	6	—	St. Mary, Stoke Newington.
1	—	—	—	4	—	1	—	1	—	—	—	—	1	21	1	Hackney.
—	—	1	—	—	—	—	—	—	—	—	—	1	—	3	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	1	—	1	—	2	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Strand.†
—	—	—	—	—	—	1	—	—	—	1	—	—	—	3	—	Holborn.‡
1	—	1	1	—	—	—	—	—	—	1	—	—	—	8	3	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	1	—	—	—	4	1	St. Luke, Middlesex.
—	—	—	—	1	—	—	—	—	—	—	1	1	—	4	3	London, City of.§
1	—	—	—	2	—	—	—	—	—	2	—	1	—	7	—	Shoreditch.
3	—	1	—	1	—	1	—	2	1	3	—	1	—	18	1	Bethnal Green.
1	—	—	—	—	—	2	1	—	—	3	—	—	1	7	2	Whitechapel.‖
—	—	—	—	—	—	1	—	—	—	2	—	—	—	9	3	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	—	Limehouse.
1	—	2	—	—	1	—	—	—	—	1	—	—	—	7	2	Mile End Old Town.
1	—	4	1	2	—	—	—	—	—	4	—	1	—	20	4	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	St. Saviour, Southwark.
—	—	1	—	—	—	—	—	1	—	—	—	—	—	6	—	St. George, Southwark.
—	—	3	—	1	1	—	—	2	—	—	1	—	—	12	4	Newington.
—	—	—	—	—	—	1	—	—	—	—	—	—	—	1	—	St. Olave, Southwark.
—	—	—	—	2	—	—	—	1	—	—	—	1	—	10	1	Bermondsey.
—	—	—	—	—	—	—	—	—	—	1	—	1	—	4	1	Rotherhithe.
—	—	1	—	3	—	3	1	2	—	—	—	3	—	30	2	Lambeth.
1	1	3	—	2	—	—	—	—	—	—	—	2	—	13	2	Battersea.
2	—	1	—	—	—	1	—	1	—	3	—	1	—	21	2	Wandsworth
2	1	—	—	2	—	1	—	4	1	2	—	2	—	20	3	Camberwell.
5	—	2	2	3	—	—	—	1	—	1	—	1	—	27	3	Greenwich.
1	—	1	—	—	—	—	—	—	—	—	—	—	—	3	1	Lewisham.
1	—	11	1	4	—	7	—	4	1	3	—	4	1	34	3	Woolwich.
53	4	42	3	39	2	23	6	10	1	7	2	3	1	180	19	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

Enteric Fever—*continued.*

Weekly Statement, 3rd Quarter, 1895.

District	Sanitary Areas.	Population (1891).	July 6. Cases.	July 6. Deaths.	July 13. Cases.	July 13. Deaths.	July 20. Cases.	July 20. Deaths.	July 27. Cases.	July 27. Deaths.	Aug. 3. Cases.	Aug. 3. Deaths.	Aug. 10. Cases.	Aug. 10. Deaths.
	London	4,232,118	[a]43	5	53	11	47	5	49	9	47	12	53	8
	(*Administrative County*)	-	[b]*42*	—	*52*	—	*41*	—	*47*	—	*47*	—	*52*	—
W. District.	Kensington	166,308	2	—	—	—	1	—	4	—	—	—	2	—
	Fulham	91,639	1	—	1	1	—	—	—	—	1	—	—	—
	Hammersmith	97,239	1	—	—	—	—	—	2	—	1	—	2	—
	Paddington	117,846	—	—	—	—	4	—	1	2	1	1	—	—
	Chelsea	96,253	1	—	1	1	2	—	—	—	1	—	—	—
	St. George, Hanover Sq.*	78,599	—	—	—	—	—	—	—	—	—	—	—	—
	Westminster	55,539	—	—	1	—	—	—	—	—	—	1	1	—
	St. James, Westminster	24,995	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	—	—	1	—	2	—	7	—	3	—	2	1
	Hampstead	68,416	—	—	1	—	1	—	1	—	2	—	3	—
	St. Pancras	234,379	—	—	1	—	9	—	—	—	7	—	2	—
	Islington	319,143	1	—	1	—	—	—	1	—	3	1	3	1
	St. Mary, Stoke Newington	30,936	..	—	1	—	—	—	—	—	—	—	—	—
	Hackney	198,606	3	—	7	2	3	—	5	1	2	1	2	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	1	—	1	—	—	—	2	—	1	—
	St. Martin-in-the-Fields	14,616	1	—	—	—	—	—	—	—	—	—	—	—
	Strand†	25,217	—	—	—	—	—	—	1	—	—	—	—	—
	Holborn‡	34,043	—	—	—	—	—	—	—	—	—	—	—	—
	Clerkenwell	66,216	4	—	—	—	—	—	—	—	—	—	2	—
	St. Luke, Middlesex	42,440	1	—	3	1	—	—	1	—	—	—	—	—
	London, City of§	37,583	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Shoreditch	124,009	1	1	9	—	1	3	3	1	1	—	4	—
	Bethnal Green	129,132	4	1	2	—	1	—	—	—	1	—	3	—
	Whitechapel‖	74,420	1	—	1	1	—	—	—	—	2	—	—	—
	St. George-in-the-East	45,795	—	—	—	—	—	—	—	—	—	—	1	—
	Limehouse	57,376	—	—	4	—	1	—	2	—	—	1	4	—
	Mile End Old Town	107,592	2	—	2	1	—	—	4	—	—	—	1	—
	Poplar	166,748	2	—	1	—	6	1	2	—	4	2	—	—
S. District.	St. Saviour, Southwark	27,177	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Southwark	59,712	—	—	—	—	1	—	1	1	—	1	—	—
	Newington	115,804	1	—	1	—	2	—	2	—	1	1	2	—
	St. Olave, Southwark	12,723	—	—	—	—	—	—	—	—	—	—	—	—
	Bermondsey	84,682	1	—	—	—	1	—	—	—	—	—	—	1
	Rotherhithe	39,255	—	—	—	—	—	—	1	—	1	—	—	—
	Lambeth	275,203	3	—	2	1	3	—	—	—	5	—	7	1
	Battersea	150,558	1	1	—	—	1	—	2	1	—	1	—	—
	Wandsworth	156,942	2	—	1	—	1	—	2	—	1	—	2	1
	Camberwell	235,344	2	1	2	—	1	—	1	1	3	1	4	1
	Greenwich	165,413	3	—	1	—	—	—	—	—	2	—	3	1
	Lewisham	92,647	1	—	—	1	—	—	3	—	—	—	—	—
	Woolwich	40.848	2	—	4	1	1	1	1	—	—	1	1	—
	Plumstead	52,436	2	1	4	1	4	—	2	2	2	—	1	1
	Lee	36,103	—	—	—	—	—	—	—	—	1	—	—	—
	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications.*
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

Enteric Fever—*continued.* Weekly Statement, 3rd Quarter, 1895—*continued.* Aug. 17. Cases.	Aug. 17. Deaths.	Aug. 24. Cases.	Aug. 24. Deaths.	Aug. 31. Cases.	Aug. 31. Deaths.	Sept. 7. Cases.	Sept. 7. Deaths.	Sept. 14. Cases.	Sept. 14. Deaths.	Sept. 21. Cases.	Sept. 21. Deaths.	Sept. 28. Cases.	Sept. 28. Deaths.	Totals for 3rd Quarter, 1895. Cases.	Totals for 3rd Quarter, 1895. Deaths.	Sanitary Areas.
50	15	75	9	93	10	104	21	114	16	95	20	84	10	909	151	London.
49	—	*72*	—	*89*	—	*96*	—	*111*	—	*87*	—	*83*	—	*868*	—	(*Administrative County.*)
3	—	5	—	2	2	1	2	1	—	1	—	2	—	24	4	Kensington.
2	—	3	1	6	—	2	—	2	—	2	—	1	—	21	2	Fulham.
1	2	2	—	2	—	3	—	1	—	1	—	1	1	17	3	Hammersmith.
—	—	—	—	1	—	4	—	4	—	1	—	1	—	17	3	Paddington.
—	—	—	—	2	—	2	—	2	—	1	1	1	1	13	3	Chelsea.
—	—	—	—	1	—	1	—	1	—	2	2	1	—	6	2	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	1	—	—	—	—	—	3	1	Westminster.
—	1	—	—	1	—	3	1	1	—	—	1	—	—	5	3	St. James, Westminster.
1	1	4	1	3	—	4	2	6	1	2	—	4	—	39	6	St. Marylebone.
—	—	1	—	1	—	3	—	—	—	3	1	2	—	18	1	Hampstead.
2	1	1	—	3	—	4	1	2	1	6	1	6	1	43	5	St. Pancras.
1	—	2	1	4	1	6	—	8	—	8	—	4	—	42	4	Islington.
—	—	—	—	—	—	1	—	1	—	—	—	4	—	7	—	St. Mary, Stoke Newington.
2	2	2	1	8	—	10	3	8	1	11	3	13	1	76	15	Hackney.
—	1	1	—	1	—	—	—	—	—	2	—	—	—	9	1	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	1	—	—	—	—	—	—	1	1	St. Martin-in-the-Fields.
1	—	1	1	—	—	—	—	—	—	2	—	—	—	5	1	Strand.†
1	—	1	—	1	—	—	—	—	—	—	—	1	—	4	—	Holborn.‡
1	—	—	—	1	—	3	—	3	—	—	1	1	—	15	1	Clerkenwell.
—	—	1	—	—	1	1	—	1	—	—	—	—	—	8	2	St. Luke, Middlesex.
2	1	4	—	2	—	—	—	1	—	—	—	1	—	10	1	London, City of.§
—	1	—	—	7	1	4	1	4	—	5	—	2	1	41	9	Shoreditch.
3	1	4	—	4	—	7	—	10	1	2	2	4	—	45	5	Bethnal Green.
2	—	—	—	—	—	1	—	1	—	—	—	1	—	9	1	Whitechapel.‖
2	—	—	—	2	1	1	—	1	—	2	—	—	1	9	2	St. George-in-the-East.
—	—	1	1	2	—	2	—	2	1	1	—	2	—	21	3	Limehouse.
1	—	3	—	5	—	2	—	5	2	5	2	2	—	32	5	Mile End Old Town.
3	1	7	—	2	1	9	4	11	1	13	—	5	—	63	10	Poplar.
1	—	—	—	—	—	2	—	—	—	—	—	—	—	3	—	St. Saviour, Southwark.
—	—	1	1	—	—	—	—	2	3	2	—	—	—	7	6	St. George, Southwark.
1	—	2	—	4	—	—	—	1	—	1	—	5	1	23	2	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
—	—	—	—	2	—	2	1	2	—	1	—	1	—	10	2	Bermondsey.
2	—	—	—	2	1	3	—	—	2	4	1	1	—	14	4	Rotherhithe.
3	—	3	1	6	—	6	—	4	—	2	1	3	1	47	5	Lambeth.
2	—	1	—	2	—	—	—	6	1	2	1	5	—	22	5	Battersea.
3	1	2	—	3	—	—	—	3	1	4	—	1	—	25	3	Wandsworth.
7	1	14	—	9	—	11	4	16	1	6	2	6	1	82	13	Camberwell.
1	—	4	—	4	1	5	—	1	—	2	—	2	—	28	2	Greenwich.
—	—	2	—	1	1	—	1	—	—	—	—	—	—	7	3	Lewisham.
1	—	3	—	1	—	—	—	1	—	—	1	1	1	16	5	Woolwich.
1	1	—	1	—	—	1	—	1	—	1	—	—	—	19	7	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

§ Including Inner Temple (population, 96).

‖ Including Tower of London (population, 868).

	Sanitary Areas.	Population (1891).	ENTERIC FEVER—*continued.* Weekly Statement, 4th Quarter, 1895. Oct. 5. Cases.	Oct. 5. Deaths.	Oct. 12. Cases.	Oct. 12. Deaths.	Oct. 19. Cases.	Oct. 19. Deaths.	Oct. 26. Cases.	Oct. 26. Deaths.	Nov. 2. Cases.	Nov. 2. Deaths.	Nov. 9. Cases.	Nov. 9. Deaths.	Nov. 16. Cases.	Nov. 16. Deaths.
	London	4,232,118	[a]149	21	112	21	134	18	109	20	124	15	139	23	124	22
	(*Administrative County*)	-	[b]*137*	—	*107*	—	*125*	—	*100*	—	*113*	—	*134*	—	*107*	—
W. District.	Kensington	166,308	4	—	1	1	3	—	1	1	3	—	5	—	2	1
	Fulham	91,639	3	—	2	1	5	1	2	—	2	—	—	1	3	—
	Hammersmith	97,239	3	—	1	—	2	—	—	—	—	—	1	—	5	—
	Paddington	117,846	1	—	4	1	7	—	2	—	2	—	2	—	4	2
	Chelsea	96,253	3	—	1	—	7	*1	3	1	6	1	8	—	—	—
	St. George, Hanover Sq.*	78,599	—	1	1	—	3	1	2	—	1	1	1	—	2	—
	Westminster	55,539	1	—	—	—	1	—	—	—	2	—	1	—	1	—
	St. James, Westminster	24,995	1	—	—	—	—	—	1	1	1	—	—	—	—	—
N. District.	St. Marylebone	142,404	9	—	1	—	5	2	3	—	4	1	6	—	2	—
	Hampstead	68,416	3	2	2	—	2	—	2	—	3	1	—	—	1	—
	St. Pancras	234,379	8	—	2	—	10	1	5	3	9	2	8	2	7	1
	Islington	319,143	13	1	11	1	10	1	5	1	11	—	8	2	11	3
	St. Mary, Stoke Newington	30,936	1	—	1	—	—	—	1	—	3	—	1	1	—	—
	Hackney	198,606	11	2	17	2	7	2	10	—	13	2	19	—	8	3
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	1	1	—	1	—	—	—	—	—	2	—
	St. Martin-in-the-Fields	14,616	4	—	—	—	1	—	—	—	—	—	—	—	1	—
	Strand†	25,217	2	—	1	—	—	—	2	—	—	—	4	—	—	—
	Holborn‡	34,043	—	—	2	—	—	—	—	—	—	—	3	—	2	—
	Clerkenwell	66,216	1	—	2	—	3	—	2	1	3	1	2	1	1	—
	St. Luke, Middlesex	42,440	1	1	1	—	—	—	2	—	2	—	3	1	3	—
	London, City of §	37.583	3	—	2	2	2	1	2	—	2	—	1	1	—	—
E. District.	Shoreditch	124,009	5	2	8	—	5	—	4	—	3	—	3	3	3	—
	Bethnal Green	129,132	8	1	1	2	5	—	7	2	3	—	4	1	4	1
	Whitechapel‖	74,420	3	—	2	1	1	—	—	1	1	1	—	—	1	—
	St. George-in-the-East	45,705	1	—	1	—	1	—	3	1	4	—	—	—	1	—
	Limehouse	57,376	1	—	—	—	4	1	4	1	2	2	3	—	1	—
	Mile End Old Town	107,592	2	1	1	1	3	2	2	—	3	—	2	—	2	2
	Poplar	166,748	10	2	10	1	5	2	7	—	3	—	8	2	5	2
S. District.	St. Saviour, Southwark	27,177	—	—	—	—	—	—	2	—	1	—	—	1	—	—
	St. George, Southwark	59,712	1	—	1	—	4	—	1	—	1	—	1	—	3	—
	Newington	115,804	2	2	2	1	8	—	1	1	2	1	3	1	4	—
	St. Olave, Southwark	12,723	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Bermondsey	84,682	2	—	—	—	—	—	3	—	—	—	2	—	2	1
	Rotherhithe	39,255	—	—	1	—	—	—	3	1	—	—	1	—	2	—
	Lambeth	275,203	10	1	10	4	5	—	5	—	6	—	9	2	7	—
	Battersea	150,558	4	1	4	1	7	1	4	2	5	—	8	—	4	—
	Wandsworth	156,942	3	3	5	—	2	1	2	1	5	1	5	1	1	1
	Camberwell	235,344	13	1	7	1	4	—	11	1	4	1	4	—	4	—
	Greenwich	165,413	6	—	6	—	8	—	2	1	8	—	10	1	9	3
	Lewisham	92,647	2	—	—	—	3	—	—	—	2	—	2	—	1	—
	Woolwich	40,848	—	—	—	—	—	1	—	—	—	—	—	—	1	—
	Plumstead	52,436	2	—	—	—	—	—	1	—	3	—	1	2	14	1
	Lee	36,103	1	—	1	—	—	—	1	—	1	—	—	—	—	1
	Port of London	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications.*
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

ENTERIC FEVER—*continued.*

Weekly Statement, 4th Quarter, 1895—*continued.* Nov. 23. Cases.	Deaths.	Nov. 30. Cases.	Deaths.	Dec. 7. Cases.	Deaths.	Dec. 14. Cases.	Deaths.	Dec. 21. Cases.	Deaths.	Dec. 28. Cases.	Deaths.	Totals for 4th Quarter, 1895. Cases.	Deaths.	Grand Totals for Year 1895. Cases.	Deaths.	Sanitary Areas.
120	12	117	20	88	16	131	20	96	11	56	22	1,499	241	3,721	396	London.
108	—	*106*	—	*84*	—	*122*	—	*87*	—	*51*	—	*1,381*	—	*3,513*	—	(*Administrative County.*)
4	—	3	1	—	—	6	—	4	—	1	—	37	4	102	15	Kensington.
6	1	2	1	1	1	1	—	1	—	—	—	28	6	65	12	Fulham.
2	1	2	1	1	—	1	—	1	1	1	—	20	3	59	12	Hammersmith.
1	—	1	—	—	—	—	—	1	—	1	1	26	4	73	13	Paddington.
2	—	9	3	3	—	—	—	3	—	2	1	47	7	82	13	Chelsea.
2	—	1	—	3	1	—	1	2	1	—	—	18	6	41	9	St. George, Hanover Sq.*
—	1	—	—	2	1	2	—	—	—	—	—	10	2	28	3	Westminster.
—	—	1	1	1	1	1	—	—	—	1	—	7	3	14	6	St. James, Westminster.
4	2	7	—	7	1	2	—	2	1	—	—	52	7	144	23	St. Marylebone.
1	—	2	—	1	—	3	—	2	—	3	—	25	3	66	9	Hampstead.
6	—	4	2	5	—	6	3	4	1	2	1	76	16	170	30	St. Pancras.
12	—	10	1	6	2	11	2	8	—	9	2	125	16	214	30	Islington.
—	—	1	—	—	—	1	—	2	—	—	—	11	1	32	4	St. Mary, StokeNewington.
14	1	19	3	12	3	2	3	7	—	3	2	142	23	272	45	Hackney.
—	—	—	—	1	—	2	—	—	—	—	—	7	1	26	2	St. Giles and St. George, Bloomsbury.
2	—	1	—	—	—	1	—	—	—	—	—	10	—	16	1	St. Martin-in-the-Fields.
—	—	—	—	1	—	—	—	1	—	—	1	11	1	23	5	Strand.†
1	—	2	—	—	—	1	—	—	—	1	—	12	—	23	—	Holborn.‡
2	1	1	1	1	—	2	—	3	—	—	—	23	5	58	11	Clerkenwell.
2	—	—	—	—	—	3	—	1	—	—	—	18	2	38	6	St. Luke, Middlesex.
—	—	—	—	—	—	1	—	2	—	2	—	17	4	40	13	London, City of.§
2	—	5	1	5	—	2	1	3	1	—	1	48	9	109	22	Shoreditch.
10	—	3	—	2	—	4	1	3	—	—	1	54	9	136	17	Bethnal Green.
—	—	—	—	—	—	2	—	—	—	2	2	12	5	32	10	Whitechapel.‖
—	—	1	—	2	1	2	—	1	—	1	—	18	2	41	7	St. George-in-the-East.
1	—	2	1	1	—	—	—	1	—	1	—	21	5	55	10	Limehouse.
2	—	4	—	2	1	7	1	3	1	2	1	35	10	83	17	Mile End Old Town.
4	1	4	1	5	2	7	2	6	—	3	—	77	15	181	33	Poplar.
—	—	—	—	1	—	1	—	—	—	—	—	5	1	11	1	St. Saviour, Southwark
1	—	1	—	—	—	3	—	1	—	1	—	19	—	45	7	St. George, Southwark.
—	—	1	—	1	—	2	—	2	—	—	—	28	6	89	15	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	2	St. Olave, Southwark.
4	1	2	—	—	1	3	1	2	—	2	1	22	5	60	11	Bermondsey.
—	—	—	—	—	—	—	—	—	—	—	—	7	1	40	9	Rotherhithe.
6	2	2	—	4	—	15	1	8	2	4	2	91	14	226	26	Lambeth.
5	—	3	—	4	—	10	—	3	1	1	3	62	9	141	22	Battersea.
4	—	5	2	2	—	6	1	5	1	2	1	47	13	137	26	Wandsworth.
7	—	4	—	7	1	7	1	6	—	8	2	86	8	246	33	Camberwell.
7	1	7	1	5	—	7	—	6	1	1	—	82	8	156	17	Greenwich.
2	—	4	—	1	—	4	1	1	—	1	—	23	1	43	7	Lewisham.
1	—	2	—	—	—	—	—	—	—	—	—	4	1	54	9	Woolwich.
1	—	1	—	1	—	1	—	—	—	—	—	25	3	230	30	Plumstead.
1	—	—	—	—	—	2	1	1	—	1	—	9	2	15	3	Lee.
1	—	—	—	—	—	—	—	—	—	—	—	2	—	3	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 16). ‖ Including Tower of London (population, 868).

Simple Continued Fever.

Weekly Statement, 1st Quarter, 1895.

	Sanitary Areas.	Population (1891).	Jan. 5. Cases.	Jan. 5. Deaths.	Jan. 12. Cases.	Jan. 12. Deaths.	Jan. 19. Cases.	Jan. 19. Deaths.	Jan. 26. Cases.	Jan. 26. Deaths.	Feb. 2. Cases.	Feb. 2. Deaths.	Feb. 9. Cases.	Feb. 9. Deaths.
	London	4,232,118	[a] 4	—	—	—	5	—	5	1	1	—	2	—
	(*Administrative County*)	-	[b] 4	—	—	—	4	—	4	—	1	—	2	—
W. District.	Kensington	166,308	—	—	—	—	—	—	—	—	—	—	1	—
	Fulham	91,639	—	—	—	—	—	—	1	—	—	—	—	—
	Hammersmith	97,239	—	—	—	—	—	—	—	—	—	—	—	—
	Paddington	117,846	—	—	—	—	—	—	—	—	—	—	—	—
	Chelsea	96,253	—	—	—	—	—	—	—	—	—	—	—	—
	St. George Hanover Sq.*	78,599	—	—	—	—	—	—	1	—	—	—	—	—
	Westminster	55,539	—	—	—	—	—	—	—	—	—	—	—	—
	St. James, Westminster	24,995	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	—	—	—	—	—	—	—	—	—	—	—	—
	Hampstead	68,416	—	—	—	—	—	—	—	—	—	—	—	—
	St. Pancras	234,379	—	—	—	—	—	—	—	—	—	—	—	—
	Islington	319,143	—	—	—	—	—	—	—	1	—	—	1	—
	St. Mary, Stoke Newington	30,936	—	—	—	—	—	—	—	—	—	—	—	—
	Hackney	198,606	—	—	—	—	1	—	—	—	—	—	—	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	—	—
	St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	—	—	—	—	—	—
	Strand†	25,217	—	—	—	—	—	—	—	—	—	—	—	—
	Holborn‡	34,043	—	—	—	—	—	—	—	—	—	—	—	—
	Clerkenwell	66,216	—	—	—	—	—	—	—	—	—	—	—	—
	St. Luke, Middlesex	42,440	—	—	—	—	—	—	—	—	—	—	—	—
	London, City of§	37,583	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Shoreditch	124,009	—	—	—	—	—	—	—	—	—	—	—	—
	Bethnal Green	129,132	—	—	—	—	—	—	—	—	—	—	—	—
	Whitechapel‖	74,420	—	—	—	—	—	—	—	—	—	—	—	—
	St. George-in-the-East	45,795	1	—	—	—	—	—	—	—	—	—	—	—
	Limehouse	57,376	—	—	—	—	—	—	—	—	—	—	—	—
	Mile End Old Town	107,592	—	—	—	—	—	—	—	—	—	—	—	—
	Poplar	166,748	3	—	—	—	—	—	—	—	1	—	—	—
S. District.	St. Saviour, Southwark	27,177	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Southwark	59,712	—	—	—	—	—	—	—	—	—	—	—	—
	Newington	115,804	—	—	—	—	—	—	—	—	—	—	—	—
	St. Olave Southwark	12,723	—	—	—	—	—	—	—	—	—	—	—	—
	Bermondsey	84,682	—	—	—	—	—	—	—	—	—	—	—	—
	Rotherhithe	39,255	—	—	—	—	—	—	—	—	—	—	—	—
	Lambeth	275,203	—	—	—	—	3	—	1	—	—	—	—	—
	Battersea	150,558	—	—	—	—	—	—	2	—	—	—	—	—
	Wandsworth	156,942	—	—	—	—	—	—	—	—	—	—	—	—
	Camberwell	235,344	—	—	—	—	—	—	—	—	—	—	—	—
	Greenwich	165,413	—	—	—	—	1	—	—	—	—	—	—	—
	Lewisham	92,647	—	—	—	—	—	—	—	—	—	—	—	—
	Woolwich	40,848	—	—	—	—	—	—	—	—	—	—	—	—
	Plumstead	52,436	—	—	—	—	—	—	—	—	—	—	—	—
	Lee	36,103	—	—	—	—	—	—	—	—	—	—	—	—
	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications*.
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

SIMPLE CONTINUED FEVER—*continued.*

Weekly Statement, 1st Quarter, 1895—*continued.*														Totals for 1st Quarter, 1895.		Sanitary Areas.
Feb. 16.		Feb. 23.		Mar. 2.		Mar. 9.		Mar. 16.		Mar. 23.		Mar. 30.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
—	—	1	1	1	—	—	—	1	—	2	—	1	1	23	3	London.
—	—	1	—	1	—	—	—	1	—	2	—	1	—	21	—	(*Administrative County.*)
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Kensington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Fulham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hammersmith.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Paddington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Chelsea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. James, Westminster.
—	—	—	1	1	—	—	—	—	—	—	—	—	—	1	1	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hampstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Pancras.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	Islington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Mary, Stoke Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Hackney.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Strand.†
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Holborn.‡
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	London, City of.§
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Shoreditch.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bethnal Green.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Whitechapel.‖
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Limehouse.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Mile End Old Town.
—	—	1	—	—	—	—	—	1	—	—	—	—	—	6	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bermondsey.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Rotherhithe.
—	—	—	—	—	—	—	—	—	—	2	—	1	1	7	1	Lambeth.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	Battersea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Wandsworth.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Camberwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Greenwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Woolwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

Sanitary Areas.		Population (1891).	SIMPLE CONTINUED FEVER—*continued*. Weekly Statement, 2nd Quarter, 1895. April 6. Cases.	April 6. Deaths.	April 13. Cases.	April 13. Deaths.	April 20. Cases.	April 20. Deaths.	April 27. Cases.	April 27. Deaths.	May 4. Cases.	May 4. Deaths.	May 11. Cases.	May 11. Deaths.
London		4,232,118	3	—	3	—	4	—	—	—	3	—	2	1
(*Administrative County*)		—	*3*	—	*2*	—	*4*	—	—	—	*3*	—	*2*	—
W. District.	Kensington	166,308	—	—	—	—	—	—	—	—	—	—	—	—
	Fulham	91,639	—	—	—	—	—	—	—	—	—	—	—	—
	Hammersmith	97,239	2	—	—	—	—	—	—	—	—	—	—	—
	Paddington	117,846	—	—	—	—	—	—	—	—	—	—	—	—
	Chelsea	96,253	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Hanover Sq.[c]	78,599	—	—	—	—	—	—	—	—	—	—	—	—
	Westminster	55,539	—	—	—	—	—	—	—	—	—	—	—	—
	St. James, Westminster	24,995	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	—	—	—	—	—	—	—	—	—	—	—	—
	Hampstead	68,416	—	—	—	—	—	—	—	—	—	—	—	—
	St. Pancras	234,379	—	—	—	—	—	—	—	—	—	—	—	—
	Islington	319,143	1	—	—	—	3	—	—	—	—	—	—	—
	St. Mary, Stoke Newington	30,936	—	—	—	—	—	—	—	—	—	—	—	—
	Hackney	198,606	—	—	1	—	—	—	—	—	—	—	—	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	—	—
	St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	—	—	—	—	—	—
	Strand†	25,217	—	—	—	—	—	—	—	—	—	—	—	—
	Holborn‡	34,043	—	—	—	—	—	—	—	—	—	—	—	—
	Clerkenwell	66,216	—	—	—	—	—	—	—	—	—	—	—	—
	St. Luke, Middlesex	42,440	—	—	—	—	—	—	—	—	—	—	—	—
	London, City of§	37,583	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Shoreditch	124,009	—	—	—	—	—	—	—	—	—	—	—	—
	Bethnal Green	129,132	—	—	—	—	—	—	—	—	—	—	—	—
	Whitechapel‖	74,420	—	—	—	—	—	—	—	—	—	—	—	—
	St. George-in-the-East	45,795	—	—	—	—	—	—	—	—	—	—	—	—
	Limehouse	57,376	—	—	—	—	—	—	—	—	—	—	—	—
	Mile End Old Town	107,592	—	—	—	—	—	—	—	—	—	—	—	—
	Poplar	166,748	—	—	2	—	—	—	—	—	—	—	—	—
S. District.	St. Saviour, Southwark	27,177	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Southwark	59,712	—	—	—	—	—	—	—	—	—	—	—	—
	Newington	115,804	—	—	—	—	—	—	—	—	1	—	—	1
	St. Olave, Southwark	12,723	—	—	—	—	—	—	—	—	—	—	—	—
	Bermondsey	84,682	—	—	—	—	—	—	—	—	—	—	—	—
	Rotherhithe	39,255	—	—	—	—	—	—	—	—	—	—	—	—
	Lambeth	275,203	—	—	—	—	—	—	—	—	1	—	2	—
	Battersea	150,558	—	—	—	—	1	—	—	—	1	—	—	—
	Wandsworth	156,942	—	—	—	—	—	—	—	—	—	—	—	—
	Camberwell	235,344	—	—	—	—	—	—	—	—	—	—	—	—
	Greenwich	165,413	—	—	—	—	—	—	—	—	—	—	—	—
	Lewisham	92,647	—	—	—	—	—	—	—	—	—	—	—	—
	Woolwich	40,848	—	—	—	—	—	—	—	—	—	—	—	—
	Plumstead	52,436	—	—	—	—	—	—	—	—	—	—	—	—
	Lee	36,103	—	—	—	—	—	—	—	—	—	—	—	—
	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications*.
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
[c] Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

SIMPLE CONTINUED FEVER—*continued.*

Weekly Statement, 2nd Quarter, 1895—*continued.* May 18. Cases.	May 18. Deaths.	May 25. Cases.	May 25. Deaths.	June 1. Cases.	June 1. Deaths.	June 8. Cases.	June 8. Deaths.	June 15. Cases.	June 15. Deaths.	June 22. Cases.	June 22. Deaths.	June 29. Cases.	June 29. Deaths.	Totals for 2nd Quarter, 1895. Cases.	Totals for 2nd Quarter, 1895. Deaths.	Sanitary Areas.
1	—	3	—	—	—	5	—	4	—	1	1	—	—	29	2	London.
1	—	*3*	—	—	—	*5*	—	*4*	—	*1*	—	—	—	*28*	—	(*Administrative County.*)
—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	Kensington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Fulham.
—	—	—	—	—	—	1	—	—	—	—	—	—	—	3	—	Hammersmith.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Paddington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Chelsea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. James, Westminster.
—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	—	St. Marylebone.
—	—	—	—	—	—	1	—	1	—	—	—	—	—	2	—	Hampstead.
—	—	2	—	—	—	—	—	—	—	—	—	—	—	2	—	St. Pancras.
—	—	—	—	—	—	1	—	—	—	—	—	—	—	5	—	Islington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Mary, Stoke Newington
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Hackney.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Strand.†
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Holborn.‡
—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	London, City of.§
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Shoreditch.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bethnal Green.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Whitechapel.‖
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Limehouse.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Mile End Old Town.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bermondsey.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Rotherhithe.
—	—	—	—	—	—	1	—	1	—	—	1	—	—	5	1	Lambeth.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	Battersea.
1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Wandsworth.
—	—	—	—	—	—	1	—	—	—	—	—	—	—	1	—	Camberwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Greenwich.
—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Woolwich
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 138), Staple Inn (population, 21), and Furnival's Inn (population, 121).

§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

	Sanitary Areas.	Population (1891.)	SIMPLE CONTINUED FEVER—*continued.* Weekly Statement, 3rd Quarter, 1895. July 6. Cases.	July 6. Deaths.	July 13. Cases.	July 13. Deaths.	July 20. Cases.	July 20. Deaths.	July 27. Cases.	July 27. Deaths.	Aug. 3. Cases.	Aug. 3. Deaths.	Aug. 10. Cases.	Aug. 10. Deaths.
	London	4,232,118	a4	—	3	—	2	1	4	—	—	1	1	—
	(*Administrative County*)	..	b4	—	3	—	2	—	4	—	—	—	1	—
W. District.	Kensington	166,308	—	—	—	—	—	—	—	—	—	—	—	—
	Fulham	91,639	—	—	—	—	—	—	—	—	—	—	1	—
	Hammersmith	97,239	—	—	—	—	—	—	—	—	—	—	—	—
	Paddington	117,846	—	—	—	—	—	—	—	—	—	—	—	—
	Chelsea	96,253	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Hanover Sq.*	78,599	—	—	—	—	1	—	—	—	—	1	—	—
	Westminster	55,539	—	—	—	—	—	—	—	—	—	—	—	—
	St. James, Westminster	24,995	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	—	—	—	—	—	—	—	—	—	—	—	—
	Hampstead	68,416	1	—	—	—	—	—	—	—	—	—	—	—
	St. Pancras	234,379	—	—	—	—	—	—	—	—	—	—	—	—
	Islington	319,143	—	—	1	—	—	1	3	—	—	—	—	—
	St. Mary, Stoke Newington	30,936	—	—	—	—	—	—	—	—	—	—	—	—
	Hackney	198,606	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	—	—
	St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	—	—	—	—	—	—
	Strand†	25,217	—	—	—	—	—	—	—	—	—	—	—	—
	Holborn‡	34,043	—	—	—	—	—	—	—	—	—	—	—	—
	Clerkenwell	66,216	—	—	—	—	—	—	—	—	—	—	—	—
	St. Luke, Middlesex	42,440	—	—	1	—	—	—	—	—	—	—	—	—
	London, City of§	37,583	—	—	—	—	1	—	—	—	—	—	—	—
E. District.	Shoreditch	124,009	—	—	—	—	—	—	—	—	—	—	—	—
	Bethnal Green	129,132	1	—	—	—	—	—	—	—	—	—	—	—
	Whitechapel‖	74,420	—	—	—	—	—	—	—	—	—	—	—	—
	St. George-in-the-East	45,795	—	—	—	—	—	—	—	—	—	—	—	—
	Limehouse	57,376	—	—	—	—	—	—	—	—	—	—	—	—
	Mile End Old Town	107,592	—	—	—	—	—	—	—	—	—	—	—	—
	Poplar	166,748	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. Saviour, Southwark	27,177	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Southwark	59,712	—	—	—	—	—	—	—	—	—	—	—	—
	Newington	115,804	—	—	—	—	—	—	—	—	—	—	—	—
	St. Olave, Southwark	12,723	—	—	—	—	—	—	—	—	—	—	—	—
	Bermondsey	84,682	—	—	—	—	—	—	—	—	—	—	—	—
	Rotherhithe	39,255	—	—	—	—	—	—	—	—	—	—	—	—
	Lambeth	275,203	2	—	1	—	—	—	1	—	—	—	—	—
	Battersea	150,558	—	—	—	—	—	—	—	—	—	—	—	—
	Wandsworth	156,942	—	—	—	—	—	—	—	—	—	—	—	—
	Camberwell	235,344	—	—	—	—	—	—	—	—	—	—	—	—
	Greenwich	165,413	—	—	—	—	—	—	—	—	—	—	—	—
	Lewisham	92,647	—	—	—	—	—	—	—	—	—	—	—	—
	Woolwich	40,848	—	—	—	—	—	—	—	—	—	—	—	—
	Plumstead	52,436	—	—	—	—	—	—	1	—	—	—	—	—
	Lee	36,103	—	—	—	—	—	—	—	—	—	—	—	—
	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—

a Totals of actual *notifications.*
b Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

SIMPLE CONTINUED FEVER—*continued.*

Aug. 17. Cases.	Aug. 17. Deaths.	Aug. 24. Cases.	Aug. 24. Deaths.	Aug. 31. Cases.	Aug. 31. Deaths.	Sept. 7. Cases.	Sept. 7. Deaths.	Sept. 14. Cases.	Sept. 14. Deaths.	Sept. 21. Cases.	Sept. 21. Deaths.	Sept. 28. Cases.	Sept. 28. Deaths.	Totals for 3rd Quarter, 1895. Cases.	Totals for 3rd Quarter, 1895. Deaths.	Sanitary Areas.
		Weekly Statement, 3rd Quarter, 1895—*continued.*														
—	—	1	—	3	—	1	—	5	—	4	1	—	—	28	3	London.
—	—	1	—	3	—	1	—	4	—	4	—	—	—	27	—	(*Administrative County.*)
—	—	—	—	1	—	—	—	—	—	1	1	—	—	2	1	Kensington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Fulham.
—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	Hammersmith.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Paddington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Chelsea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. James, Westminster.
—	—	1	—	—	—	—	—	1	—	—	—	—	—	2	—	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Hampstead.
—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	St. Pancras.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	1	Islington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Mary, Stoke Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hackney.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Strand.†
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Holborn.‡
—	—	—	—	1	—	—	—	—	—	—	—	—	—	1	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	London, City of.§
—	—	—	—	1	—	—	—	—	—	—	—	—	—	1	—	Shoreditch.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Bethnal Green.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Whitechapel.‖
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Limehouse.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Mile End Old Town.
—	—	—	—	—	—	—	—	2	—	1	—	—	—	3	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bermondsey.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Rotherhithe.
—	—	—	—	—	—	—	—	—	—	1	—	—	—	5	—	Lambeth.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Battersea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Wandsworth.
—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	Camberwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Greenwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Woolwich.
—	—	—	—	—	—	1	—	—	—	—	—	—	—	2	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

	Sanitary Areas.	Population (1891).	SIMPLE CONTINUED FEVER—*continued*. Weekly Statement, 4th Quarter, 1895. Oct. 5. Cases.	Oct. 5. Deaths.	Oct. 12. Cases.	Oct. 12. Deaths.	Oct. 19. Cases.	Oct. 19. Deaths.	Oct. 26. Cases.	Oct. 26. Deaths.	Nov. 2. Cases.	Nov. 2. Deaths.	Nov. 9. Cases.	Nov. 9. Deaths.	Nov. 16. Cases.	Nov. 16. Deaths.
	London	4,232,118	[a]3	—	2	—	5	—	2	—	2	—	—	—	2	—
	(*Administrative County*)		[b]*3*	—	*2*	—	*5*	—	*2*	—	*2*	—	—	—	*2*	—
W. District.	Kensington	166,308	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Fulham	91,639	—	—	—	—	—	—	—	—	1	—	—	—	—	—
	Hammersmith	97,239	—	—	—	—	—	—	1	—	—	—	—	—	—	—
	Paddington	117,846	—	—	—	—	1	—	—	—	—	—	—	—	—	—
	Chelsea	96,253	—	—	—	—	1	—	—	—	—	—	—	—	1	—
	St. George, Hanover Sq.*	78,599	1	—	—	—	—	—	—	—	—	—	—	—	—	—
	Westminster	55,539	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. James, Westminster	24,995	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Hampstead	68,416	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Pancras	234,379	—	—	—	—	1	—	—	—	—	—	—	—	—	—
	Islington	319,143	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Mary, Stoke Newington	30,936	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Hackney	198,606	—	—	—	—	1	—	—	—	—	—	—	—	—	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Strand†	25,217	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Holborn‡	34,043	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Clerkenwell	66,216	2	—	1	—	—	—	—	—	—	—	—	—	—	—
	St. Luke, Middlesex	42,440	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	London, City of§	37,583	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Shoreditch	124,009	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Bethnal Green	129,132	—	—	—	—	—	—	—	—	1	—	—	—	—	—
	Whitechapel	74,420	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. George-in-the-East	45,795	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Limehouse	57,376	—	—	—	—	—	—	—	—	—	—	—	—	1	—
	Mile End Old Town	107,592	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Poplar	166,748	—	—	1	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. Saviour, Southwark	27,177	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Southwark	59,712	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Newington	115,804	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Olave, Southwark	12,723	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Bermondsey	84,682	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Rotherhithe	39,255	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lambeth	275,203	—	—	—	—	1	—	—	—	—	—	—	—	—	—
	Battersea	150,558	—	—	—	—	—	—	1	—	—	—	—	—	—	—
	Wandsworth	156,942	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Camberwell	235,344	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Greenwich	165,413	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lewisham	92,647	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Woolwich	40,848	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Plumstead	52,436	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lee	36,103	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications*.
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

SIMPLE CONTINUED FEVER—*continued.*

Weekly Statement, 4th Quarter, 1895—*continued.* Nov. 23. Cases.	Nov. 23. Deaths.	Nov. 30. Cases.	Nov. 30. Deaths.	Dec. 7. Cases.	Dec. 7. Deaths.	Dec. 14. Cases.	Dec. 14. Deaths.	Dec. 21. Cases.	Dec. 21. Deaths.	Dec. 28. Cases.	Dec. 28. Deaths.	Totals for 4th Quarter, 1895. Cases.	Totals for 4th Quarter, 1895. Deaths.	Grand Totals for Year 1895. Cases.	Grand Totals for Year 1895. Deaths.	Sanitary Areas.
5	1	5	—	—	1	3	—	1	—	2	—	32	2	112	10	London.
5	—	*5*	—	—	—	*3*	—	*1*	—	*2*	—	*32*	—	*108*	—	(*Administrative County.*)
—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	1	Kensington.
—	1	—	—	—	—	—	—	—	—	—	—	1	1	3	1	Fulham.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	5	—	Hammersmith.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	Paddington.
—	—	—	—	—	—	—	—	—	—	—	—	2	—	2	—	Chelsea.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	3	1	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Westminster.
1	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	St. James, Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	1	St. Marylebone.
—	—	—	—	—	1	—	—	—	—	—	—	—	1	3	1	Hampstead.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	4	—	St. Pancras.
1	—	—	—	—	—	1	—	—	—	—	—	2	—	11	2	Islington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Mary, Stoke Newington.
1	—	2	—	—	—	—	—	—	—	—	—	4	—	6	—	Hackney.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Strand.†
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Holborn.‡
—	—	—	—	—	—	—	—	—	—	—	—	3	—	5	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	London, City of.§
1	—	1	—	—	—	1	—	—	—	—	—	3	—	4	—	Shoreditch.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	2	—	Bethnal Green.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Whitechapel.‖
—	—	—	—	—	—	—	—	1	—	—	—	1	—	2	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	Limehouse.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Mile End Old Town.
—	—	—	—	—	—	—	—	—	—	1	—	2	—	13	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bermondsey.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Rotherhithe.
1	—	—	—	—	—	—	—	—	—	1	—	3	—	20	2	Lambeth.
—	—	1	—	—	—	—	—	—	—	—	—	2	—	6	—	Battersea.
—	—	1	—	—	—	1	—	—	—	—	—	2	—	3	—	Wandsworth.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	Camberwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Greenwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Woolwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

District	Sanitary Areas.	Population (1891).	Typhus Fever. Weekly Statement, 1895. Jan. 5. Cases.	Feb. 2. Cases.	Mar. 9. Deaths.	Mar. 16. Cases.	Totals for 1st Quarter, 1895. Cases.	Totals for 1st Quarter, 1895. Deaths.	April 27. Cases.	May 18. Cases.	June 8. Deaths.	June 15. Cases.	June 29. Cases.
	London - - -	4,232,118	a1	1	1	2	4	1	2	1	1	1	1
	(*Administrative County*) -	-	b1	1	—	2	4	—	2	1	—	1	1
W. District.	Kensington	166,308	—	—	—	—	—	—	—	—	—	—	—
W. District.	Fulham	91,639	—	—	—	—	—	—	—	—	—	—	—
W. District.	Hammersmith	97,239	—	—	—	—	—	—	—	—	—	—	—
W. District.	Paddington	117,846	—	—	—	—	—	—	—	—	—	—	—
W. District.	Chelsea	96,253	—	—	—	—	—	—	—	—	—	—	—
W. District.	St. George, Hanover Sq.*	78,599	—	—	—	—	—	—	—	—	—	—	—
W. District.	Westminster	55,539	—	—	—	—	—	—	—	—	—	—	—
W. District.	St. James, Westminster	24,995	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	—	—	—	—	—	—	—	—	—	—	—
N. District.	Hampstead	68,416	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Pancras	234,379	—	—	—	—	—	—	—	—	—	—	—
N. District.	Islington	319,143	—	—	1	2	2	1	—	—	—	—	—
N. District.	St. Mary, Stoke Newington	30,936	—	—	—	—	—	—	—	—	—	—	—
N. District.	Hackney	198,606	—	—	—	—	—	—	—	—	—	—	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	—
Central District.	St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	—	—	—	—	—
Central District.	Strand†	25,217	—	—	—	—	—	—	—	—	—	—	—
Central District.	Holborn‡	34,043	—	—	—	—	—	—	—	—	—	—	—
Central District.	Clerkenwell	66,216	—	—	—	—	—	—	—	—	1	1	—
Central District.	St. Luke, Middlesex	42,440	—	—	—	—	—	—	—	—	—	—	—
Central District.	London, City of§	37,583	—	—	—	—	—	—	—	—	—	—	—
E. District.	Shoreditch	124,009	—	—	—	—	—	—	—	—	—	—	—
E. District.	Bethnal Green	129,132	—	—	—	—	—	—	—	—	—	—	—
E. District.	Whitechapel‖	74,420	—	—	—	—	—	—	—	1	—	—	—
E. District.	St. George-in-the-East	45,795	—	—	—	—	—	—	—	—	—	—	—
E. District.	Limehouse	57,376	—	—	—	—	—	—	—	—	—	—	—
E. District.	Mile End Old Town	107,592	—	—	—	—	—	—	—	—	—	—	—
E. District.	Poplar	166,748	—	—	—	—	—	—	—	—	—	—	1
S. District.	St. Saviour, Southwark	27,177	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. George, Southwark	59,712	—	—	—	—	—	—	—	—	—	—	—
S. District.	Newington	115,804	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. Olave, Southwark	12,723	—	—	—	—	—	—	—	—	—	—	—
S. District.	Bermondsey	84,682	1	—	—	—	1	—	—	—	—	—	—
S. District.	Rotherhithe	39,255	—	1	—	—	1	—	—	—	—	—	—
S. District.	Lambeth	275,203	—	—	—	—	—	—	—	—	—	—	—
S. District.	Battersea	150,558	—	—	—	—	—	—	—	—	—	—	—
S. District.	Wandsworth	156,942	—	—	—	—	—	—	—	—	—	—	—
S. District.	Camberwell	235,344	—	—	—	—	—	—	—	—	—	—	—
S. District.	Greenwich	165,413	—	—	—	—	—	—	2	—	—	—	—
S. District.	Lewisham	92,647	—	—	—	—	—	—	—	—	—	—	—
S. District.	Woolwich	40,848	—	—	—	—	—	—	—	—	—	—	—
S. District.	Plumstead	52,436	—	—	—	—	—	—	—	—	—	—	—
S. District.	Lee	36,103	—	—	—	—	—	—	—	—	—	—	—
S. District.	Port of London	—	—	—	—	—	—	—	—	—	—	—	—

a Totals of actual *notifications*.
b Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235).
† Including Middle Temple (population, 95).

TYPHUS FEVER—*continued.*

Weekly Statement, 1895—*continued.*															Grand Totals for Year, 1895.		Sanitary Areas.
Totals for 2nd Quarter, 1895.		July 20.	Aug. 31.		Totals for 3rd Quarter, 1895.		Oct. 5.	Oct. 12.	Oct. 19.		Nov. 2.	Nov. 23.	Totals for 4th Quarter, 1895.				
Cases.	Deaths.	Cases.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Cases.	Cases.	Deaths.	Deaths.	Cases.	Cases.	Deaths.	Cases.	Deaths.	
5	1	1	1	1	2	1	*1*	1	1	1	1	1	4	2	15	5	London.
5	—	*1*	*1*	—	*2*	—	1	*1*	*1*	—	—	*1*	4	—	*15*	—	(*Administrative County*).
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Kensington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Fulham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hammersmith.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Paddington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Chelsea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. James, Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	—	1	Hampstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Pancras.
—	—	—	—	—	—	—	1	1	—	—	—	—	2	—	4	1	Islington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Mary, Stoke Newington.
—	—	—	1	1	1	1	—	—	—	—	—	—	—	—	1	1	Hackney.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Strand.†
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Holborn.‡
1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	London, City of.§
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Shoreditch.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bethnal Green.
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Whitechapel.‖
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Limehouse.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Mile End Old Town.
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Bermondsey.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Rotherhithe.
—	—	1	—	—	1	—	—	—	—	—	—	—	—	—	1	—	Lambeth.
—	—	—	—	—	—	—	—	—	1	1	—	—	1	1	1	1	Battersea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Wandsworth.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Camberwell.
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	Greenwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Woolwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	1	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136) Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

APPENDIX B.

No. 1.

Report on an Inquiry into the Relations of Asiatic Cholera and Cholera Nostras, or English Cholera; by Dr. Klein, F.R.S.

App. B. No. 1. On the Relations of Asiatic Cholera and Cholera Nostras; by Dr. Klein.

In the report of the Medical Officer on "Cholera in England in 1893" it has been shown in regard of certain local occurrences of cholera in England in the autumn of 1893 that the symptoms, pathology, and bacterioscopic tests of the cases indicated that they were of the nature of the disease known as epidemic or Asiatic cholera.

In regard of some such localised groups of cases it was shown that prior to their occurrence importation of a previous case or cases of cholera from an infected locality had actually or probably taken place. Such were the facts with reference to the cholera outbreaks that occurred in Hull and in Grimsby, in Ashbourne, and in other places.

But also it was shown that, about the same time, isolated attacks occurred in other localities, which, in their clinical, pathological, and bacteriological characters, differed in no way from the above cases of Asiatic cholera, though they did differ in the circumstance that their connexion, direct or indirect, with antecedent cholera, could not be established. To this class belonged cases in Westminster, Fulham, Southwark, Derby, Coton Hill, and elsewhere.

Further, during the same period, August to November 1893, isolated attacks were recorded in various localities presenting the principal clinical characters of cholera—vomiting, purging of rice-water-like evacuations, cramps, cold extremities, altered face and voice, suppression of urine—but which did not end fatally and which did not, moreover, on bacterioscopic examination, respond to the tests of Asiatic cholera. Of this class were cases at Clacton-on-Sea, and several cases brought into St. Bartholomew's Hospital from different districts in London.

The question therefore arose as to whether these isolated cholera-like cases, ending in recovery—as also others of the same type ending fatally (Mitcham, Warrington, Gloucester)—were cases of Asiatic cholera or of cholera nostras.

It is obvious that if it could be proved that just as the *presence* of Koch's vibrio in the dejecta or in the intestine is characteristic of Asiatic cholera, and occurs in no other intestinal disease, so, too, its invariable *absence* from the dejecta or the intestinal contents of isolated attacks of seeming cholera is characteristic of cases in no way connected, directly or indirectly, with true cholera infection, the problem would be simple enough. But unfortunately this is not the case. It has been placed on record in connexion with the Hamburg epidemic in 1892 (Hueppe), and with epidemic outbreaks in several localities in Russia in 1892, that the dejecta of a small per-centage of the cases that occurred in those epidemics, cases indistinguishable in clinical respects from Asiatic cholera, did *not* contain, though tested by the most trustworthy methods, Koch's vibrio. In Berlin, too, there occurred in 1892 a number of cases which gave positive evidence in this sense, and were declared therefore to be Asiatic cholera, whereas others occurring at the same time, and not yielding Koch's vibrio, were declared to be cholera nostras. Similarly in London in 1893, as stated in the cholera report referred to above, some isolated fatal cases (Westminster, Fulham, Kennington, Southwark) occurred which yielded positive evidence, whereas other isolated cases, some fatal some not fatal, but not differing in clinical or pathological characters, failed to reveal the presence of Koch's vibrio (Newington, Mitcham, Hackney, Clerkenwell). The

former were consequently declared by me as "not distinguishable from Asiatic cholera," the latter as "negative."

The diagnosis between Asiatic cholera and cholera nostras, or English cholera, in circumstances where infection from a previous focus is not demonstrable, if it is to have proper foundation, must extend to the examination of a large number of cases occurring separately and at times when no Asiatic cholera can be demonstrated to exist in this country. Now, if it should be found that under these conditions no Koch's vibrio is found in the dejecta of the patients, even after the most careful search by approved methods, then the declaration of such cases as not of the Asiatic type would seem to be justified. In this connexion it ought to be borne in mind that Koch's vibrio, when it does occur, is readily demonstrated in culture, as was proved in several isolated instances occurring in 1893 where this vibrio was mixed in the intestinal contents with crowds of other bacteria, and where the pathological appearances were not unmistakably typical of Asiastic cholera, while the clinical characters were just like those in cases of sporadic cholera.* In all these cases the nature and the contents of the ileum were not different from what is the case in English cholera. The mucous membrane was injected, the contents fluid or grumous, and exhibiting crowds of various bacilli, only a few of which could under the microscope be identified as commas. Nevertheless the latter were, by cultivation, easily picked out as the Koch's cholera vibrio.

The presumption that these were cases of Asiatic cholera, and that other similar cases in which the vibrio was not demonstrable were not so, acquires considerably greater force when viewed in the light of facts since to hand about isolated cases occurring in non-cholera years, and not traceable to new importation. Such cases occurred in 1894. During the whole of the summer and autumn of 1894 there were no series of cholera cases in any locality in England—not even in those places in which in the previous year (1893) such had been the case, as, for instance, Grimsby, Hull, Rotherham, North Bierley, Ashbourne.†

* The cases in question are reported on by me in the Board's cholera volume for 1893, under :—(*a*) Morton (Gainsborough), No. X., page 179; (*b*) Handsworth, No. XIII., page 179; (*c*) Fulham case, No. XV., page 179; (*d*) Croydon Borough, No. XXII., page 180; (*e*) Liverpool case, No. XLI., page 184.

† So far as importations of cholera in 1894 are concerned, the following statement will be found at page 260 of the Report of the Medical Officer for 1894-95.

During 1894, notwithstanding the presence of cholera at numerous continental ports having trade with this country, only six cases of cholera, or disease suspected to be cholera, were detected on board vessels from foreign. These cases all occurred on two vessels entering the Port of London from St. Petersburg.

On August 7th, the "Balmore" (19 hands) arrived at the Port of London, having left St. Petersburg on July 31st. On her arrival it was ascertained that one of the crew had been attacked with symptoms suspicious of cholera on August 5th, and had died at sea shortly before the vessel reached the Port of London, and, further, that there were four cases of suspicious illness on board. The four men suffering from suspicious illness were at once removed to the port authority's hospital, and the corpse was taken to the mortuary at the port hospital, where a post-mortem examination was made, and a portion of bowel sent to Dr. Klein for bacteriological examination. Dr. Klein reported the result of his examination to be typical of true cholera. Specimens of the dejecta of the four patients admitted to hospital were also submitted to Dr. Klein, who reported that, as regards three of the cases, the presence of Koch's comma-bacilli was demonstrated, whilst in the fourth case no positive result as to commas was obtained. All four patients ultimately recovered. The vessel was disinfected, and no further cases were reported.

On August 15th the "Bedford" (21 hands) reached the Port of London, having left St. Petersburg on August 6th. Upon arrival it was ascertained that the steward had sickened on August 12th with characteristic choleraic symptoms. From the history of the case, the port medical officer was of opinion that this man was convalescing from an attack of cholera. He was at once removed to the port hospital, where he recovered. The vessel was dealt with in the ordinary way.

So too in 1895 there were no cases of Asiatic cholera imported into England, and there was no recrudescence of cholera here in localities in which cholera of the Asiatic type had been previously demonstrated.

Thus the cases which occurred during the summers and autumns of 1894 and 1895 in England, and which were clinically of the character of cholera, acquired from a bacteriological point of view, especial importance. For it is clear that if in none of these cases the vibrio of Koch could be demonstrated, the problem would become simplified, and the inference that these cases were epidemiologically and bacteriologically *not* cases of the Asiatic type to a corresponding extent strengthened. But if on the contrary, the vibrio of Koch could be demonstrated in the bodies of persons not connected in any way with the cholera localities of 1893, the bacteriological test as an important help in distinguishing between Asiatic cholera and cholera nostras would become practically worthless.

The following cases were examined in 1894.

Case I., July 23rd.—H. K.; Dr. Beasley sent a stool of a patient living at Tividale, the history of whose case was reported by Dr. Sweeting as follows :—

> On the morning of Thursday, July 19th, 1894, a telegram, addressed to the Medical Officer of the Board, was received from Dr. Beasley, the Medical Officer of Health for Rowley Regis Urban Sanitary District, in these words: "A case of cholera at Tividale, probably English variety ; letter to follow."
>
> About 4 p.m. on the same day a letter arrived from Dr. Beasley, containing particulars as to the case referred to in his telegram. Dr. Beasley stated that he had just returned from Tividale, where, in company with Dr. Price, of Dudley Port, he had seen a case which both Dr. Price and himself "considered to be cholera." The patient, he added, was a man aged 29, residing at Dudley Road, Tividale.
>
> In company with Dr. Beasley and the inspector of nuisances, I proceeded, on July 20th, to Tividale, some four miles distant from Rowley Regis, and visited the patient at his house. I found him in bed, lying on his back and suffering from an attack of uncontrollable hiccough, which so prevented him from regulating his respiratory movement as to render conversation with him well nigh impossible. In condition he appeared much pulled down, as one after excessive diarrhœa and vomiting. His pulse was 100 and weak, his temperature, as taken by the Medical Officer of Health, 97°. His respirations were so disturbed by the acts of hiccough as to render their enumeration valueless, and these disturbances had, no doubt, some effect upon the frequency of his pulse. His abdomen was distended, and there was evidently much intestinal peristalsis. The tongue was covered uniformly with a light brown moist fur. On light pressure he complained of some tenderness over the pyloric end of his stomach. There were no spots detectable, nor was there any splenic enlargement which could be ascertained either by percussion or palpation. There was no detectable distension of the bladder. His general condition—with the exception of the hiccough—showed, the Medical Officer of Health informed me, a very marked improvement on that of the day previous, when he had been quite collapsed.
>
> From the patient, his wife, and Dr. Beasley, I gathered the following history :—
>
> The patient had been "ailing" slightly for the last three weeks, having been restless at night, and during the day somewhat irritable. He had, however, been working overtime recently.
>
> On Saturday, July 7th, patient went to Birmingham, but was only there a short time, and partook of nothing other than a glass of beer.
>
> On Sunday (July 15th), patient felt "miserable" after his dinner, which consisted of some meat and a considerable amount of peas. He

did not go for a walk on Sunday evening, as was his wont, but remained indoors. On Sunday he had altogether three or four motions, but did not regard this as very unusual. He was not out of bed during Sunday night. On the morning of Monday (July 16th) the man rose at his usual time, but before leaving home had a very liquid motion. On arriving at the works he passed another liquid motion, and at frequent intervals during the day he continued to do the same. The motions were, he stated, "like water," but he was unable to notice the colour. The amount passed at each motion was excessive, and at times "would have filled a chamber pot." Patient, however, was not apparently troubled during Monday night, and in the evening went over to Duddley for a short time; he took nothing to eat or drink while there. On Tuesday morning (July 17th) patient went to work, but during the day had numerous motions of liquid nature. After having some peas and tomatoes he was violently purged, so much so that he spent nearly two hours in the closet. On Tuesday evening a friend advised some "herb tea," which he took, but shortly after vomited it up. On Tuesday night he apparently spent a restless night, but was not troubled with diarrhœa. On Wednesday morning (July 18th) patient got up as usual, and after passing a liquid motion went to his work. At 7.45 a.m., however, he had to return home, and after spending some time in the closet was too collapsed to resume work. He commenced again to vomit, and from that time vomited and passed liquid motions very freely. Dr. Young (Dr. Price's assistant) was called in, and after examining the patient prescribed medicine. The patient had now taken to his bed, was vomiting frequently, and passing his motions under him. The motions were, according to his wife, of a pale brown colour. At about 11 a.m. cramps commenced in the toes, and extended upwards "all over the body." The cramps were attended with intense pain, so much so that the patient called out with it. The attacks were very frequent, and most marked in the calves of the legs.

The condition of the patient at this time is graphically described by the Medical Officer of Health, who then visited him. He says: "When I saw him this evening at eight o'clock the symptoms were "as follows:—He was lying on his back with his knees drawn up; the "abdomen was flattened and collapsed. He was very much prostrated, the face was pinched, and the eyes sunk in their sockets. "The skin on the hands was wrinkled and slightly cyanotic. The "tongue was moist and slightly coated, the respiration quickened; "pulse 126 and thready; temperature, axilla 99°. He complained of "griping pains in the bowels, inability to sleep, thirst, and severe "cramps in the extremities if he made the least movement. His wife "told me that he had voided per rectum a great quantity of brown "watery fluid, which became lighter in colour with each successive "motion, until it was of a pale yellow colour. He also vomited at "frequent intervals everything he swallowed, and a watery fluid as "well. The motions for the last three hours are not so profuse, and "are passed in bed."

The cramps and diarrhœa ceased at 9 p.m. on Wednesday, but the vomiting still continued. On Thursday (July 19th) at 4 a.m., the vomiting ceased, and at 8.30 a.m. the patient's bowels were open, the motion being still liquid, but of a thicker consistence than formerly. From this time the patient's condition apparently continued to improve, except that on Friday morning (July 20th) he suffered severely from the hiccough before alluded to.

R. D. R. S.

The stool received by me from Dr. Beasley was solid material of deep green colour. On microscopic examination no epithelial flakes or leucocytes could be seen in it. There were, however, present crowds of bacteria, which did not differ in number or appearance from those found in ordinary fæcal matter. Cultivations of material from the stool

were made in peptone salt solution and in gelatine plates, but only innumerable colonies of typical *bacillus coli* were obtained.

A second stool, fluid, yellow, from the same case, was received on July 25th.

The result of microscopic and cultural examination was the same as in the first instance.

Case II.—Dr. Beasley sent me from Rowley Regis a piece of ileum of a patient (Elizabeth G——), dead on July 31st, after a severe attack of diarrhœa. The following is his report of the case, dated 31st July:—

> The patient, a young woman aged 20 years, had been suffering from diarrhœa ever since Tuesday, July 24th. I was called to see her at 12 o'clock of the night of July 30th, and found her vomiting, in great pain in the bowels, and passing stool involuntarily. The temperature was 104°, pulse 108, respiration 30. The body was bathed in a clammy sweat; the face was shrunken, and of a dusky hue. Turpentine stupes were applied over the abdomen. Sulphuric ether, opium, and hæmatoxylon were administered, and liquid food was given at frequent intervals. I saw her again at 1 p.m. this afternoon; she was then pulseless and collapsed. She died at 5 p.m. No medical assistance had been obtained until I saw her last night.
>
> J. S. B.

The intestine received by me was congested and filled with fluid, in which were large masses of greyish mucus flakes. Under the microscope these flakes contained continuous masses of epithelial cells detached from the mucous membrane; there were no leucocytes present. In the gelatinous matrix of the flakes there were present in pure condition lines, streaks, and irregular masses of short straight rods. The appearances were identical with those found in the typical cholera flakes, viz., *rows, and lines, and streaks of bacteria*—the "fish-in-stream" arrangement of Koch—except that in this case the bacteria were not comma-bacilli, but straight rods.

Cultivations were made with the flakes on gelatine and on agar plates, and in peptone salt solution, with the result of finding that the above bacteria in the flakes were *bacillus coli* in pure culture.

This case is of particular interest, since, as regards the condition of the ileum, the epithelial flakes contained therein, and the arrangement of the bacteria in these flakes, it did not differ from a case of typical Asiatic cholera. In clinical respects, too, this case bore much resemblance to Asiatic cholera. The sole important bacteriological difference between it and a typical case of Asiatic cholera, such as we had in 1893, consisted in the circumstance that the bacteria present in pure culture and in the "fish-in-stream" arrangement were in typical cholera cases Koch's vibrio, whereas in this case, No. II., they were bacillus coli. Above all, this case is interesting from the fact that in the district in which it occurred a series of cases of cholera of the Asiatic type had been recorded in the previous year, and that the bacterioscopic examination of the intestine of one of them had yielded Koch's vibrio.

It ought to be added that in 1894 no further cases of cholera occurred in this district beyond those (Nos. I. and II.) just described; in 1893 there had been eight cases in all.

Case III.—C.N., a hall-porter, æt. 60, died at St. George's Hospital on August 10th, under symptoms strongly suggestive of cholera. The following notes respecting the case were supplied by Dr. Hamer:—

> C.N. had suffered from diarrhœa on and off for seven years; was the subject of prolapse.

Went for his holiday to Brighton, returning about one week before the commencement of his illness. His friends say he rarely leaves the Egyptian Hall, and save for the Brighton visit cannot give any account of his movements prior to his illness.

On August 7th drank some "sour milk," and told a friend whom he saw on the morning of the 8th that this had upset him. Suffered from diarrhœa and vomiting on the 8th; on the 9th symptoms became aggravated, and "everything ran through him."

At 5 p.m. on 9th admitted to St. George's Hospital; was blue and cold; complained of cramps; his voice was very husky. Diarrhœa ceased for a time after admission; but on the morning of the 10th he passed six motions, which are said to have been milky. Only one motion was saved, and that was sent to Dr. Klein.

Died at noon on the 10th.

Post mortem made by Dr. Rolleston about 4 p.m. (Dr. R. will send notes). The bowel was somewhat injected, and several ounces of the intestinal contents were saved, and these have been taken to Dr. Klein.

W. H. H.

Post-mortem Examination on Charles N., August 10th, 1894, 4 *p.m.*

Rigor mortis absent in arms, present on hands, jaws, and legs.

Peritoneum normal; not particularly sticky or soapy.

Colour of intestines normal; some congestion of lower coils of the ileum, but not more than is often seen from hypostasis. Stomach contains milk; mucosa somewhat thickened; no signs of recent inflammation. Small tumour in submucosa near the cardiac end; microscopically a fasciculated fibroma.

The contents of small and large intestine amounted to about a pint; some of the intestinal contents handed to Dr. Hamer, August 11th.

Solitary follicles somewhat prominent in small intestine; a few œdematous projections of the mucous membrane in small intestine.

Peyer's patches and mesenteric glands normal; aortic glands pigmented.

Vermiform appendix and colon normal.

Gall bladder contains dark, thick bile, in considerable quantities. Bile duct pervious and normal.

Bladder empty.

A fairly normal amount of blood in the veins; fluid, and not in any way thick or like treacle.

H. D. R.

The motion passed before death, which was sent to me, consisted of copious thin whitish fluid. The ileum subsequently forwarded to me by the Medical Officer of the London County Council was congested, and contained similar thin, fluid, whitish material. Under the microscope there were present numerous small groups of milk globules (the patient had taken some "sour milk" before the attack), and a few small groups of epithelial cells. There were also recognisable crowds of straight, short, oval bacteria, isolated and in masses, and a few long cylindrical rods. Peptone cultivations and gelatine plate cultivations having been made, the majority of the above bacilli were found to be *proteus vulgaris*, a minority *bacillus coli*.

Case IV.—Dr. Blackburn, Medical Officer of Health of Monk Bretton, sent a piece of ileum of a person supposed to have died from cholera after eight hours' illness. Also he sent the following account of the case:—

John P., aged 56, Mauds Terrace, Monk Bretton, colliery deputy, went to Hull quite well on the 21st of July 1894, by workmen's trip from Monk Bretton Colliery.

On the 23rd July he was well, and continued to work daily from that date up to August 10th, when he returned home about 12 o'clock in the forenoon complaining of diarrhœa. He stated to his wife that he had been frequently purged during the night in the coalpit.

Dr. McSwiney furnished me with a report of P.'s illness, a copy of which I enclose.

Notes on Cases of John P. by Dr. MacSwiney.

I saw him at 2.30 on Friday afternoon (August 10th). He was in bed, utterly collapsed, vomiting and passing from the bowels a thin white fluid in large quantities. He scarcely spoke, except to complain of violent cramps in legs, arms, and abdomen. His extremeties (also ears, nose, and head) were quite cold, and the temperature taken in the axilla did not reach 95°.

He never rallied, became gradually comatose, and died about 8 o'clock the same evening.

He had been working at the pit the night before, and only came home at 12 o'clock midday. He had suffered from diarrhœa for a day before.

The mucous membrane of the piece of ileum sent to me was much congested, and contained a grey grumous fluid with numerous flakes. Under the microscope numerous connected masses of epithelium were recognised, and in the gelatinous matrix of the flakes there were streaks and irregular masses of short straight bacilli, *in arrangement similar* to that which is the case in typical cholera flakes. Cultivations were made in peptone salt solution in agar and in gelatine plates, and the result was that colonies of *bacillus coli* only were obtained in all the cultures in a pure state; no vibrios.

This is therefore the second case (Case No. II. being the first) in which the ileum contained numerous flakes of epithelial character, and in the matrix of the flakes crowds of colon bacilli exhibiting the fish-in-stream arrangement which Koch's vibrios assume in a typical case of Asiatic cholera.

Case V.—I received from Dr. Malcolmson a piece of ileum from a man dead at Middlesbrough from acute choleraic disease. Dr. Malcolmson's notes of the case are as follows:—

> James G., aged 73 years, of Crown Street, Middlesbrough, was a night watchman at Sir Raylton Dixon and Co.'s yard. He was employed for nine weeks on board a new vessel in the docks (delayed in completion by a strike). On Sunday night he was taken ill with diarrhœa, stayed at home on Monday and Monday night, felt better on Tuesday, and went to work on Tuesday night. Was found insensible on Wednesday morning and taken to infirmary; improved somewhat, but relapsed on Wednesday night, and died. He (as far as I can ascertain) was never on board of any foreign ship; he took his drink (milk) and food with him. He had cholera, when it was epidemic here, 40 years ago, and was liable ever since to acute attacks of abdominal pain.
>
> J. A. M.

The mucous membrane of the gut was much congested; in the cavity of the ileum there was yellowish brown fluid, but no recognisable flakes. Microscopically, there were observed in the fluid crowds of short and long rods, which in peptone salt cultures and in gelatine and agar plates proved to be *bacillus coli*. There were no vibrios isolable.

Case VI.—Through the Medical Officer of the London County Council I received a piece of ileum of a man who died under symptoms

of cholera in Battersea on August 16th. The following notes of the case were obtained by Dr. Horne :—

Robert P., aged 46 years, who resided at Eversleigh Road, Battersea, and who was employed by Messrs. Vaughan and Brown, Kirby Street, Hatton Garden, art metal workers, died at his residence on August 16th, 1894, about 9.15 p.m.

Mrs. P., his relict, informed me that her husband had been subject for a long time to occasional attacks of looseness of the bowels. About six weeks ago he was unable to go to his work for a fortnight owing to "general weakness," but since that time he had been in his usual health. On Tuesday, August 14th, he had diarrhœa, necessitating his retirement to the w.c. two or three times. The following morning, August 15th, he went to work as usual. He had beefsteak pudding at an eating-house for dinner that day, and in the evening had some fried fresh haddock at home for supper. During the evening he was cheerful, and he went to bed at about 11 o'clock, apparently in his ordinary health. At 4 o'clock the next morning, August 16th, he was attacked with vomiting and diarrhœa, accompanied by severe cramp of the legs, arms, and fingers. In the course of the following two hours he was severely purged two or three times. The dejections are described by Mrs. P. as being at this time "like dirty water," and very offensive. After 6 o'clock a.m. he was unable to arise, and the evacuations (which are stated to have been copious) were passed in bed. It is not known whether he passed any urine.

Mr. Dolman, L.R.C.P., *locum tenens* for Dr. Anderson, Lavender Hill, Battersea, was called in about 8 a.m., August 16th, and he saw him several times in the course of the day.

Dr. W. H. Kempster, Medical Officer of Health, who saw the patient with Mr. Dolman, about 5 p.m., describes his condition at that time as follows : "He was semi-conscious, almost comatose, cold, "with sub-normal temperature, pulse weak and irregular. The "dejecta were typical 'rice water' stools, containing neither bile "or fæcal material. There was cramp, and almost complete "aphonia."

Mr. C. Dolman informed me that he first saw deceased about 8 a.m. on Thursday, August 16th. He was then suffering with severe cramp of the abdomen, legs, arms, and fingers. His pulse was very feeble. Temperature "just one degree below normal." Expired air felt cold. There was almost constant escape from the bowels of liquid, which was tinged slightly with yellow fæcal matter. Very soon the dejections became colourless. Mr. Dolman saw him several times in the course of the day, when, although the cramp became slightly less severe, there was no improvement. Mr. Dolman cannot say whether there was suppression of urine. About 8.45 p.m. a messenger informed Mr. Dolman that Robert P. had just died, and requested him to go and see him. Mr. Dolman did so and found Robert P. "bound up" as dead. On examination, Mr. Dolman states he found there was still feeble cardiac contraction. He injected ether over the region of the heart, but there was no reaction, and the patient died about half-an-hour afterwards. Mr. Dolman notified the case as one of cholera nostras, and certified the death as due to that disease.

The house in which Robert P. resided is free from obvious sanitary defect. Its interior is clean and tidy. Mrs. P. has four of her children living with her. None of them have suffered from any ill-health of late. Robert P. had not been away from home, except to his work, nor had any visitors been to the house for a week or two previous to the commencement of his illness.

A post-mortem examination of deceased was made at the mortuary (to which the body had been removed) 16 hours after death, by Dr. Hamer of the London County Council, Dr. Kempster and myself being present. The face had a pinched appearance. The fingers were contracted into the palms and were very dark in colour.

On opening the abdomen the intestines were seen to be injected and pink in colour. The peritoneal covering was glistening, and no lymph or adhesions were seen. The bladder was empty.

T. H.

The mucous membrane of the piece of ileum sent to me was deeply congested, and the gut contained thick, viscid, gelatinous material. Under the microscope there were seen connected masses of epithelial cells, and in the mucous matrix of the flakes there were *streaks and clumps* of short straight bacilli. Peptone salt cultures and gelatine and agar plates yielded colonies of *bacillus coli* only in a pure state. There were no comma-bacilli present.

Case VII.—W. H., æt. 40, under the care of Dr. Pye-Smith, of Guy's Hospital. The following notes were supplied by Dr. Washbourn :—

> The patient was admitted to the hospital on August 19th, 1894. Patient lives in Snow Fields, Bermondsey; is a heavy drinker; had had vomiting and diarrhœa for five days. On admission was found collapsed, frequent vomiting and diarrhœa, and some cramps in legs. The evacuations watery and of a yellowish brown colour; passes but little urine. Urine contains albumen. Temperature sub-normal. On August 23rd much collapsed. Twice transfusion with saline solution, August 20th and August 23rd. Death at 10 a.m. on August 23rd. On post-mortem examination, four hours after death, the lungs were deeply congested, kidneys tough; in the fundus of the stomach were minute hæmorrhages. The intestines appeared normal.

Dr. Washbourn added that in the contents of the intestine there were great numbers of detached epithelial cells and numerous bacteria, but no vibrios. Cultivations were made by Dr. Washbourn, and by myself also, in peptone salt solution and in gelatine plates, but no vibrios were detected; only *proteus vulgaris* was isolated.

Case VIII.—I received on August 27th a stool from Grimsby, sent by Dr. Newby, the Medical Officer of Health, as obtained from a person ill with choleraic symptoms. The following notes of the case were supplied by Dr. Bruce :—

> Michael M., bricklayer, 60 years of age, residing at Abbey Cottages, Garden Street, was attacked with slight diarrhœa on Friday night, August 24th. He went to work as usual next morning, but returned about midday, the diarrhœa having become worse. During the evening of Saturday a medical practitioner was called in, who found him in a state of collapse, and apparently dying, with sub-normal temperature, feeble pulse, husky voice, and cold extremities. Diarrhœa was profuse, and he vomited several times. He remained in a precarious condition all night, but has rallied somewhat to-day, though his temperature is still sub-normal. He will probably recover. A stool passed last night is being sent per passenger train to-day. The man has been steady and temperate in his habits.
>
> JOHN B.

The stool forwarded to me was white, watery, and contained numerous flakes. On microscopic examination there were found in it numerous bacteria, and amongst them fine spirilla-like filaments. In peptone salt cultivations and in gelatine and agar plates only colonies of *bacillus coli* were obtained.

Case IX.—I received on August 27th a piece of ileum removed from A. S. who had died at Grimsby of supposed cholera. Notes of the case by Dr. Bruce are as follows :—

> Alfred S., 51 years of age, dock labourer, residing at Humber Street, had a slight attack of diarrhœa on Monday, August 20th, which

continued all the week. It did not prevent his working. On Friday night (August 24th) he seemed no worse when he went to bed, but about 4 a.m. on Saturday morning severe diarrhœa and vomiting set in, accompanied by cramp in the legs; extremities cold and livid. He rapidly became worse, and a medical man was sent for, who found him in a state of collapse, from which he did not rally, but died at 11.30 a.m. on the 25th. A post-mortem examination was performed in the evening, and portion of bowel removed was forwarded per passenger train. The man was very dissipated, and had been drinking lately.

JOHN B.

The mucous membrane of the piece of ileum sent to me was deeply congested, and the gut contained a little mucoid substance. This was examined under the microscope and was found to contain numerous epithelial cells; also short straight bacilli *in streaks and lines*. No comma-bacilli to be detected. Cultivations in peptone salt solution and in gelatine plates showed that the above microbes were *bacillus coli* in a pure state.

Case X.—C. B., a birch broom maker, died on August 25th, 1894, at Cowper's Row, Brixton Hill. The Medical Officer of the London County Council forwarded pieces of his ileum, and the following notes of the case:—

Death of Charles B., aged 62, notified to Office by Dr. Sutton, Medical Officer of Health for Streatham.

The deceased was in his usual health on Wednesday, August 22nd, and went to work on Thursday morning, August 23rd. Complained of pain in stomach soon after he arrived at his workplace. Had some brandy, but was sick after taking it, and returned home about 3 p.m.

August 24th—Pain in stomach worse, and diarrhœa came on. Seen by Dr. Ashley; much pain in stomach, vomiting, especially after taking any food. No cramps. Stool said to be dark-coloured.

August 25th—Vomiting and diarrhœa increased. Pain worse, cramps in legs and stomach after mid-day. No alteration in voice. Temperature in mouth, 91°. Stools light brown colour. Extremities cold. Eyes sunken and features pinched and of ashy hue. Collapsed (transfusion at 8.30 p.m.). Passed urine during the morning. Became weaker, and died about 11 p.m.

The deceased's wife states that he had not been away from home since Bank Holiday (August 6th), when he visited Ramsgate. No visitors have been to the house prior to illness. The night before onset of illness had a beefsteak pudding for supper. Wife does not think he had eaten any fish or raw fruit for some weeks past.

It is stated by deceased's employer at Peckham, that there has been no illness amongst the other workpeople, viz., two men and one boy. None of these have been away from work for some weeks past.

It is believed that deceased took two Beecham's pills about mid-day August 23rd.

Post-mortem Examination.—3 p.m., August 27th.

Lungs and heart nil, except old adhesions right pleura.

Abdomen; peritoneum normal.

Intestines; some congestion of lower part of small intestines; contents bile-coloured. In large intestines, some colourless opaque glutinous matter; this is possibly due to a starch and opium enema given on day of death.

Liver; dark-coloured, soft.

Spleen; friable.

Kidneys; congested. Bladder contained about two ounces of urine.

There was a little semi-fluid matter present in some parts of the intestine sent to me, and its mucous membrane was pale; no epithelial flakes. Under the microscope crowds of bacteria; no commas. Culti-

vations in peptone salt solution, in gelatine, and in agar plates, yielded only colonies of *bacillus coli;* no vibrios.

Case XI.—I received, on September 14th, from Swansea, a piece of cæcum and of ileum of a person who died after three days' illness under symptoms suspicious of cholera. Dr. Davies, Medical Officer of Health, gave the following account of the case:

Thomas John E., æt. 18, a labourer, single, of temperate habits and healthy, had been working irregularly. On Friday, 7th September, and Saturday, 8th September, he had been engaged in loading tin plates at Forest Works, Moriston, and taking them to the docks, a distance of three miles. He took his breakfast and dinner with him to work. On Friday (7th), pork and potatoes; on Saturday (8th) morning, tea and cake. On the latter day he returned home at 3.30 p.m., bringing cake with him. He at that time complained of headache and thirst, and would take nothing but water, which he drank freely. He complained of giddiness, and was unsteady in his gait. Went to bed. On the following morning, Sunday (9th September), complained of pain in stomach and back, and as well in his head. Commenced to vomit this morning, and had frequent diarrhœa, "like water"; vomit and stools were yellow in colour (a woman who had been in attendance on him said the stools were black, and very offensive). He was seen by Mr. J. J. Gray, L.R.C.S. and P., assistant to Dr. E. Rice Morgan, on Monday (10th September). Vomiting and purging continued, and he had cramps in legs and arms. In the evening vomiting and diarrhœa ceased. On Monday night he was very restless; Tuesday (11th September), no diarrhœa or vomiting, but complained of his head. Tuesday night did not sleep. Up to Tuesday had been taking milk and soda water, which he had not retained. This evening was given small quantities of brandy and water. Wednesday (12th September), at 8 a.m., had a convulsive fit (epileptiform, in which he bit his tongue); remained unconscious until 3 in the afternoon, then recovered consciousness, but died at 7 p.m. Passed urine each day of his illness, and his stools were always coloured. Sheets which had been put into water were deeply stained yellow. Patient was not seen during his illness by Dr. Morgan (assistant's principal), or by any other medical practitioner.

I obtained permission to make an examination this evening, which was a hurried one necessarily, in order to send a portion of intestine without delay. Body that of a spare young man, not very well nourished. There was an absence of the choleraic shrunken appearance frequently seen in persons dead of Asiatic cholera. Rigor mortis strongly marked. On opening abdomen, intestines lay flat in abdominal cavity; were not shrunken, but moderately full of flatus. No sign of peritoneal inflammation; gall bladder full, urinary bladder empty. Removed portions of cæcum and ileum, without opening the bowel, for bacteriological examination.

Eben. D.

The lower part of the ileum sent to me was, to the extent of a few feet, deeply congested, dark purple; in its cavity was sanguineous fluid, with numerous grey flakes. Under the microscope, numerous epithelial cells and crowds of straight, short bacteria; bacilli and streptococci were detected, but no commas. Cultivations in peptone salt solution and in gelatine plates yielded chiefly *bacillus coli;* also a few colonies of *proteus vulgaris,* but no vibrios.

Case XII.—I received on 17th September, through Dr. Sadler, Medical Officer of Health for the Barnsley Rural District, a piece of ileum and the cæcum of a child who had died under suspicion of cholera, with history as follows:—

The medical man who was called in did not see the child alive; declined to certify, but gave it as his opinion that cholera (meaning,

he told me on the 14th, Asiatic cholera) was the cause of death. This was reported to the coroner, who, preparatory to an inquest, instructed me to make a post-mortem examination of the body, which I have done this morning.

The child, S. A. W., a girl, nine years of age, had been delicate, with cough, &c., for about six years. After accident, three years ago, she was unconscious for three days. She was one of a family of four children, living in a poorly ventilated two-roomed house.

She came home from a visit to Normanton on September 3rd. With the exception of this visit and of a few hours in a trip to Rotherham on the 4th, neither the child nor any member of its family had been away from home for some time.

On September 4th two brothers developed scarlatina, and on the 11th two other children in the house did the same. Removal to the isolation hospital was obstinately refused.

On the 13th September, at 3 a.m., the child began to vomit, and continued to vomit at frequent intervals until death, about 4 a.m. Diarrhœa came on, but there were only about six notions, which the mother described as yellow and jelly-like at first, foul and jelly-like afterwards.

At 5 p.m. she had a "fit," and died before Dr. Castle got to the house. There was never any rash. The body, when seen on the 14th, showed nothing remarkable; certainly it was not shrivelled.

To-day (66 hours after death) there was considerable swelling and discoloration from decomposition. The lungs were congested, slightly solidified, the right pleura rather adherent, heart healthy, cavities nearly empty.

Stomach and intestines distended with flatus; some grey gruelly liquid in the latter. The liver and spleen were normal. The left kidney was wanting, the right rather congested. The brain considerably congested on the surface, the blood in the sinuses quite liquid, the membranes not adherent.

I do not myself see any sufficient ground for suspecting Asiatic cholera. I think it much more likely to have been undeveloped scarlatina in a delicate child with insufficient kidney, but I thought it right that it should be thoroughly investigated by your officers.

Mich. T. S.

The mucous membrane of the intestine sent to me showed no sign of acute inflammation; in the ileum there was a little brown mucus. Microscopic examination showed crowds of bacteria; no epithelial flakes, and no vibrios. Cultivation in peptone salt solution and in gelatine plates yielded no vibrios, only *bacillus coli*.

Case XIII.—Dr. Washbourn supplies notes of the following case:—

E. H., æt. 44. Night watchman at Butler's Wharf; ate some pears in the afternoon of October 13th, which, according to the patient's account, were sound. At 9.30 p.m. on same day was suddenly taken with diarrhœa, two to three motions per hour till 2 a.m., October 14th; subsequently increasing in frequency (nearly every 10 minutes) before 6 a.m. Took, at 2 a.m., some "diarrhœa mixture," which started vomiting, and this steadily got worse. About that time cramps in calves and feet began, and were worst at 6 a.m. On admission to Guy's Hospital at 6 a.m. on October 14th, under the care of Dr. Goodhart, the patient was cold, blue, eyes sunken, voice almost a whisper. Vomiting was present, with almost constant diarrhœa, and much tenesmus; cramps very frequent, pulse small and thready, temperature sub-normal. The patient under treatment got better, and recovered in a few days.

The stools were bacterioscopically examined by Dr. Washbourn. They were of the character of rice water stools, and contained numerous bacteria, but no cholera vibrios could be isolated. I, too, received a sample of a stool of this case. It was fluid, colourless, and of the

aspect of "rice water." There were present numerous grey flakes, which under the microscope contained numerous leucocytes, but no epithelial cells. In stained specimens of the flakes there were found in the gelatinous matrix *streaks and clumps* of short, oval, and cylindrical bacilli, which in peptone salt solution and in gelatine and agar plates proved almost pure cultures of *bacillus coli*. No comma bacilli were isolated.

Case XIV.—On November 6th I received from Dr. Davies, Medical Officer of Health of Plumstead, a piece of ileum of a man (R. W., æt. 62) who died with symptoms suspicious of cholera. Dr. Davies reported on the case as follows:—

> Lived at Shott's Cottages, Abbey Wood. Quite well till Friday, 2nd November, when seized with vomiting, diarrhœa, and cramps. Stools like curdled milk, two or three in the hour. Lost his voice two to three hours before death. Died 5th November, in the morning. Rather given to drinking. No previous illness.

The mucous membrane of the intestine was deeply congested; the gut contained fluid fæcal matter. Under the microscope there were found epithelial cells, isolated and in small groups, with crowds of bacteria. Peptone cultivations and gelatine and agar plates yielded no vibrios, only colonies of *bacillus coli* and of *proteus vulgaris*.

Case XV.—On November 8th I received, through Dr. Beasley, of Rowley Regis, a bottle containing the evacuation of a patient ill with severe diarrhœa. The stool was voided in the evening of November 7th. Dr. Beasley supplied the following notes of the case:—

> I was called in to see Timothy S. this afternoon, who is suffering from choleraic symptoms, viz., severe cramp in his extremities and abdomen, vomiting, severe purging of watery matter containing mucus and some little sedimentary matter, and collapse. The patient complains of feeling very hot, but the temperature in his axilla is only normal, and the pulse is only 96 per minute. He has been troubled with diarrhœa since Sunday (4th November); remained at home on Monday, went to work on Tuesday, and was much worse again this morning, since when the symptoms have increased in severity.
>
> J. S. B.

The stool received by me was watery, and contained numerous grey shreds and flakes. Under the microscope the flakes consisted of mucus with leucocytes; no epithelial cells. In stained specimens of the flakes there were present in the hyaline matrix crowds of short rods, *in lines, streaks, and continuous masses*. Peptone salt cultures and gelatine and agar plates yielded colonies of *bacillus coli* only, in a pure state.

Case XVI.—On November 15th I received, through Dr. England, Medical Officer of Health of Spalding Rural District, a piece of ileum of a child (T. S., æt. 5) that had died under symptoms suggestive of cholera. Dr. England's notes of the case are the following:—

> On Monday, 12th November, at 8 a.m., I was called in to see Thomas S. aged five years, son of a farmer at Moulton. I found the child in a state of collapse, with pinched features, sunk eyes, and cold clammy skin; he was not sensible. His pulse was scarcely perceptible at the wrist, and his respiration was quickened, in fact, he appeared dying. I gave him a little hot brandy and water, but he had difficulty in swallowing it. I then put him in a hot bath, and had him well rubbed with mustard over the chest and abdomen, and rolled in a blanket. This revived him a little. His lips became redder and his hands and feet warmer. He took a little more brandy, but did not regain complete consciousness. He gradually sank about 9.30 a.m.

App. B. No. 1.

On the Relations of Asiatic Cholera and Cholera Nostras; by Dr. Klein.

History—The child appeared quite well on Sunday, 11th, until about 4 p.m., when he complained of headache and stomach-ache. He had been to Sunday school both morning and afternoon. He had had some rabbit broth with bread for dinner. His mother gave him nearly a teaspoonful of essence of senna and put him to bed. His bowels were first acted upon about 9 p.m., and in the bed. The mother states that the motion was not watery, but rather stiff, and smelt strongly. He was also sick once or twice, but vomited only a little watery fluid.

After 9 p.m. they do not appear to have noticed the child particularly until his father got up, about 5 a.m. He was then purged, and his hands were cold, and he would not say much. He remained much in the same state until they fetched me at 8 a.m. On moving him to put him in the bath I found that he had been much purged, especially of fluid; it had soaked into the bed. The sheets were not stained with fæcal matter, the discharge looking watery, with mucous patches, and smelt very earthy.

I made a post-mortem 48 hours after death. The body was fairly nourished; the face did not then looked so pinched as before death. The eyes were rather shrunk, and open. There was little or no rigor mortis. Over the front of the abdomen the skin looked blue, as if decomposition had already commenced. There was also well marked post-mortem ecchymosis about the back. The skin of the fingers was not puckered.

On opening the cavity of the chest, I noticed the right side of the heart, especially the auricle, to be distended, and the left lung to be rather collapsed. The right lung was congested, as was the base of the left.

The right auricle and ventricle, as well as the pulmonary arteries, contained a good deal of blood. The left ventricle had a little blood of a dark colour, and thin. The liver and spleen were engorged with blood. The gall bladder was full and distended. The kidneys were healthy. The bladder was empty and contracted. The stomach appeared healthy, and contained a thin gruelly looking fluid. There was no bile in the intestines. The small intestines were here and there distended, but not much. They were not inflamed either externally or internally. They contained a little inodorous fluid like that in the stomach. The large intestine was collapsed and empty. The descending colon and rectum presented on their inner surface patches of congestion here and there about the size of threepenny pieces. The omentum and peritoneum appeared healthy. There was no fluid in the cavities of the abdomen or chest.

The patient has not been from home or exposed in any way to contagion. A younger child has had diarrhœa, but the mother thinks it was from teething. The well water is bad, and unfit for drinking purposes. I had previously examined it, and they have been using water from another well, which is better. There is practically no drainage to the house, and the privy vault leaks into a disused ditch. The well *drains* a part of the yard. The sanitary surroundings are not good.

Geo. F. E.

The mucous membrane of the ileum sent to me was slightly congested; there was no fluid in its cavity, but a thick, grey, gelatinous, easily detachable material, covered the mucous membrane. Under the microscope this material was seen to be made up of epithelium. In stained specimens the gelatinous mass contained bacteria, isolated and in small and large groups, the latter composed entirely of short cylindrical rods. Amongst the single bacilli were some resembling the spore-bearing bacillus amylobacter, but the majority were straight, short, oval rods. Peptone salt cultures and gelatine and agar plates, yielded principally colonies of *bacillus coli;* very few colonies of *proteus vulgaris.* There were no vibrios present.

During 1895 no case of Asiatic cholera was imported into England. One case, however, of suspicious diarrhœa occurred on board the S.S. "Harold Klitgaard," that had sailed from St. Petersburg on July 10th. This vessel arrived at the mouth of the Thames on July 25th with a case of diarrhœa on board (Jno. H., æt. 27, fireman) which had commenced that day. The patient was, by Dr. Collingridge's order, at once removed to the port hospital. When admitted the patient had slight pains in abdomen; no vomiting, no cramps. The bowels were loose, the motions deficient in bile and containing undigested food. The patient soon recovered, and no other case occurred on the same vessel. Microscopic specimens, and cultures in peptone salt solution and in gelatine and agar plates of the stools of this patient, yielded no vibrios.

The following cases were examined during 1895:—

Case XVII.—Received on May 15th, through Dr. Priestley, Medical Officer of Health of Leicester, a stool of a person (C. T., æt. 56, labourer) who had an attack of supposed Asiatic cholera. Dr. Priestley's notes of the case are as follows:—

> Charles T. has suffered several times from severe and prolonged diarrhœa; he has never been out of England.
>
> *History.*—Quite well on 12th May. No deleterious food taken. At 2 a.m., May 13th, 1895, severe and sudden diarrhœa and vomiting, which continued without intermission until 8 a.m. same day. Patient presented the appearance of a typical case of eastern cholera in the algide stage; pinched look about face, which was slightly cyanosed; nose tip wrinkled; eyes dull and "fishy"; tongue dry and slightly coated; vox choleraica; hands and feet shrivelled and blue; nails blue; abdomen retracted; T. in axilla 95°·5 F.; vomiting, every 5–10 minutes, of colourless fluid with shreds and white flakes (? curdled milk); bowels acting unconsciously; motions "rice water," slightly turbid, and containing flocculi and shreds, but no blood; severe cramps at intervals in extremities and over præcordial region.
>
> Vomiting ceased by 8 a.m. 14th May, and the diarrhœa on May 15th.
>
> Voice remained aphonic for three days. T. rose to 100° F. on 14th May, but was normal in a day or two.
>
> JOSEPH P.
>
> [In letter of the 22nd May, enclosing the above particulars, Dr. Priestley says: "Clinically the case was definitely Asiatic; "etiologically and bacteriologically the case was nostras."]

The stool forwarded by Dr. Priestley consisted of thin watery fluid containing numerous small grey flakes. Under the microscope these were made up of a mucus matrix with a few leucocytes; there were no epithelial cells. Crowds of bacteria were present, but no comma bacilli could be recognised. Peptone salt cultures and gelatine and agar plates yielded numerous colonies of *proteus vulgaris*, but no vibrios.

Case XVIII.—Dr. Bryett, Medical Officer of Health of Shoreditch, brought me on June 4th a piece of ileum of a person who was taken ill with choleraic symptoms early on Thursday morning, 30th May, was collapsed on May 31st, and died in the evening. At the same time he gave the following account of the case:—

> Patient, William P., æt. 59, had lived at St. John's Road, Hoxton, about three weeks. He and his wife occupied a single room in a tenement house. The house had recently been redrained to the satisfaction of the vestry officers. P. was an ornamental engraver, working at Mr. Isaac's, in Whitechapel. He had not been at work for a day or two before his illness began, it being a time of Jews' holiday.

On the 28th May he had some cold pork for dinner, on the 29th he dined on roast lamb. He had not partaken of shell fish, or anything, so far as could be ascertained, likely to disagree with him.

At 4 a.m. on the 30th May shivering set in, followed by diarrhœa. At first the motions were brown, later in the morning "like milk." The diarrhœa only lasted about three hours. Was seen by Dr. Ryan on the morning of the 30th. At that time was feverish, and had pain in back and abdomen. When seen again on 31st was collapsed, with subnormal temperature. Died at 10 p.m. on the 31st. No vomiting or cramps in legs throughout. Said not to have passed any water during his illness.

Post-mortem on 2nd June. Small intestines injected, with milky faintly bile-stained contents. Bladder contracted and empty, kidneys rather large and somewhat pale.

The mucous membrane of the piece of ileum submitted to me was congested, but the gut contained no fluid; gelatinous flakes could, however, be easily lifted off from the surface of the mucous membrane. Under the microscope there were present in these flakes numerous short straight bacilli, which on cultivation proved to be *proteus vulgaris*. No commas or vibrios could be discovered under the microscope, or by cultivation in peptone salt solution or in gelatine and agar plates.

Case XIX.—On June 22nd I received from Dr. Williams, Medical Officer of Health of Plymouth, two samples of evacuations of a patient affected with acute choleraic diarrhœa. Dr. Williams' report on the case was as follows:—

On Thursday, 20th June, a case was reported by a medical man attending the men at the works in connexion with the new storage reservoir for Plymouth, respecting which I considered it necessary to make personal inquiry, as it so vitally concerned the town. In consultation with Dr. Revell, I saw the case, and learned the following particulars:—J. S., æt. 65, retired to rest on Tuesday night in his usual good health. At midnight he was disturbed by abdominal pain, followed by purging. Early on Wednesday morning he was much cramped in the calves of his legs and in his abdominal muscles, the cramps continuing until Thursday. On Friday morning I saw the patient, who was then practically convalescent, and expressed himself as fit for work; the motions were at this date loose, and of the colour, character, and consistence of yeast. The dejecta passed on Tuesday night, which had been kept, were of the colour of a decoction of tea to which some milk had been added, and contained flocculent floating particles. I learned that the vomit was first semi-digested food, then mucous (frothy); none was saved, so I have no personal knowledge of its character.

I further learned that the milk supply was obtained from a cottage near by, the inmates of which were, at the time of this man's attack, convalescent from severe attacks of diarrhœa with vomiting.

During the whole course of this man's illness there had been no collapse, no cyanosis, no wrinkling of the skin of the finger tips, no alteration of voice, no coldness of the body surface. Nor was there at the time of my visit any depression of the heart's action. The cottage in which the patient resided was of the usual rural type, having a shallow cesspit in front in which all sorts of refuse was thrown. There was no closet accommodation; the water supply was obtained from a well near by.

The wife of the patient some two days after my visit was attacked with diarrhœa of the ordinary summer type, but was soon convalescent.

F. M. W.

The evacuations which were sent to me by Dr. Williams were of the nature of thin fluid, stained light yellowish brown. There was a good deal of sediment, which on microscopic examination proved chiefly triple

phosphate and particles of undigested food. In the fluid there were present numerous bacteria, amongst them some chain-like cocci which on further observation proved to be the *micrococcus ureæ*. Peptone cultures and gelatine and agar plates yielded no vibrios; only colonies of *bacillus coli* were obtained.

Case XX.—On July 12th Dr. Andrewes reported the death from acute cholera of a man at the Royal Free Hospital, with the following history:—

William G., aged 55; Emerald Street, Theobald's Road, W.C. (where he had lived three years). Was well up to the night of July 9th, 1895, when he was suddenly seized with violent diarrhœa and vomiting, and with cramps in the hands and legs. Admitted to the Royal Free Hospital on July 10th, at mid-day. On admission the vomiting had ceased, but he was much collapsed, with profuse diarrhœa: the stools watery and colourless (except for a faint yellow tinge), turbid, with mucus and epithelial flakes. Cramps were severe and continuous. The collapse and cyanosis increased. Death occurred at 3.30 a.m. on July 11 (less than 36 hours from onset). Muscles twitched for 25 minutes after respiration had ceased. Rigor mortis came on very rapidly.

Post mortem (36 hours after death):—

Small man, rather thin.

Lungs emphysematous; much hypostatic congestion; old pleural adhesions.

Heart weighed 18 ounces; left ventricle hypertrophied. No valve disease.

Kidneys small, red, granular.

Liver very small, weighed only 29 ounces, but firm and natural on section.

Spleen enlarged.

Intestines—Both large and small intestines showed a little vascular injection here and there, with some œdema of the valvulæ conniventes. The contents were fluid and whitish, not quite colourless, and showed many flakes.

The ileum of this case contained fluid in which were numerous epithelial flakes, crowded with cocci and short, straight bacilli. There were no comma bacilli or vibrios obtainable; *bacillus coli* only was isolated by culture.

Case XXI.—On July 25th the Medical Officer of the London County Council sent me, through Dr. Hamer, a piece of ileum from a person at Newington, who had died under symptoms suspicious of Asiatic cholera. Dr. Hamer supplied the following notes of the case:—

Mark R., æt. 54, of Woodman's Place, New Kent Road, Newington, was a sawdust dealer, and worked at Meredith's, in Belvedere Road. He had not been further away from home than to the Central Meat Market for many months. His health was never good; 10 years ago he had suffered from a severe attack of diarrhœa. R. lived with his son, at Woodman's Place, in a two-roomed house. The premises were found on July 24th to be in a somewhat neglected condition. The watercloset was without water supply, and there was an accumulation of house refuse in the yard. The son was stated to be in perfectly good health. A sister of R.'s was suffering from diarrhœa; she did not live at Woodman's Place, and had not partaken of any food there.

R. was at work on the 19th July; on the 18th and 19th he ate some boiled pork. He had not eaten any fish or shell fish recently.

At 4 a.m. on the 20th July he was attacked by pain in the bowels, with accompanying diarrhœa and vomiting. The discharges from the bowels were described by patient's daughter as having "the "colour of anything he had taken"; sometimes they were "like

App. B. No. 1.

On the Relations of Asiatic Cholera and Cholera Nostras; by Dr. Klein.

milk"; later in the course of the illness they resembled "yellow water." Cramps in the legs supervened soon after the commencement of the illness.

On the 21st the patient seemed a little better, but he became much worse on the 22nd. He almost lost his voice, and began to be blue and cold. The cramps in the legs no longer, however, continued. Mr. Pain, who saw him on the evening of the 22nd, found him in a collapsed condition. Dr. Millson was present when patient died, on the morning of the 24th. It was not possible to say whether there was suppression of urine. Pills containing copper were administered towards the end of the illness.

At post-mortem, July 25th, the small intestine was found to be congested and almost empty. The contents were quite fluid, and had a faint green tinge. The stomach contained a much more distinctly green milky fluid. The bladder was empty.

The heart, lungs, kidneys, and liver, were of normal appearance.

The mucous membrane of the piece of ileum sent to me was much congested, of a deep red colour; it contained brownish fluid, but no recognisable flakes. Under the microscope there were found numerous small masses of epithelial cells. Crowds of bacteria were present in them, but no commas or vibrios could be found. Peptone cultures and gelatine and agar plates yielded no vibrios; *bacillus coli* only was isolated.

Case XXII.—On August 27th the Medical Officer of the London Council Council sent, through Dr. Young, a piece of ileum from a man (H. H., æt. 34), who had died at Wandsworth, under symptoms suggesting Asiatic cholera. Dr. Young supplied notes of the case as follows:—

H. H., æt. 34, of Wardley Street, Wandsworth, died 9–10 p.m., August 26th. Post-mortem at 12–1 p.m., August 27th.

Deceased at work on Friday, 23rd; employed going round collecting fat, dripping, &c., at hotels.

August 24th.—Violent diarrhœa prevented him going to work. Appears to have had some slight diarrhœa for 2–3 days previously. Vomiting towards end of day.

August 25th.—Vomiting and diarrhœa continued, and got worse. Colicky pains, and pains in legs and arms. Voice said to be husky.

August 26th.—Worse. Passed no urine. Catheter introduced in bladder in afternoon; no urine escaped. Collapsed. Died soon after 9 p.m.

The mucous membrane of the ileum sent to me showed slight patchy redness. The gut contained no fluid, only a grey, gelatinous film, adhering to the surface of the mucous membrane. Examined under the microscope this film was composed of a hyaline mucus basis, and in it were small groups of epithelial cells. No comma bacilli could be recognised amongst the numerous bacteria present. Cultivations in peptone salt solution and in gelatine and agar plates yielded no comma bacilli or vibrios; colonies of *bacillus coli* only were isolated.

Case XXIII.—On September 2nd I received from Dr. Newby, Medical Officer of Health of Grimsby, a piece of ileum from a man who had died on August 31st under symptoms strongly suspicious of Asiatic cholera. The following are Dr. Newby's notes of the case:—

A man between 60 and 70 years of age died at Veal Street this afternoon, after an illness of 18 hours, with all the symptoms of Asiatic cholera.

He was seized at about 11 p.m. yesterday, having been previously quite well, with violent purgings, and vomiting of watery flaky character. Cramps occurred in the legs and abdomen. He became

quickly collapsed, with sunken face and eyes, sub-normal temperature (95° F.), blueness of extremities, and suppression of urine.

When I saw him, immediately on becoming aware of the case, about 20 minutes before he died, he was pulseless, and had just passed a motion largely stained with blood.

Two hours after death the temperature in the rectum was 105° F. A *post-mortem* was made two hours after death, and a piece of intestine sent for examination.

The bowels were entirely empty, their surface injected, and of a soapy greasy feel.

J. N.

The mucous membrane of the ileum received by me was deeply congested; the cavity of the gut contained sanguineous fluid, but no recognisable flakes. In the fluid, crowds of short, straight rods, but no commas or vibrios could be recognised. Cultures of this fluid in peptone salt solution and in gelatine and agar plates, yielded no comma bacilli or vibrios. From the cultures, chiefly *bacillus coli*, and, in less number, *proteus vulgaris* were obtained.

Case XXIV.—On September 3rd I received through Dr. Theodore Thomson a piece of intestine, brought by him on same day from Grimsby, of a person who had died under symptoms strongly suspicious of Asiatic cholera, with history as follows:—

> Mrs. B., aged 47, was attacked by abdominal pain, sickness, and diarrhœa between 3 and 5 o'clock in the afternoon of Friday, August 30th. The stools were frequent and of yellow colour. These symptoms persisted until towards 1 o'clock in the morning of Sunday following (September 1st), when the stools and vomited material were observed to have taken on a rice-water appearance. About this time cramps in the legs and coldness of the extremities were also noted. Gradually symptoms of collapse ensued—sunken eyes, coldness of body surface, feebleness of voice. On Monday, September 2nd, these symptoms continued, accompanied by suppression of urine; and death ensued at 2.30 a.m. on September 3rd; the total duration of the illness having been about 3½ days. Previous to September 2nd the temperature was sub-normal (96° F.). On September 2nd it rose to 101° F. in the axilla.
>
> Mrs. B. had spent the day previous to that on which she was attacked in London; while there she had eaten a few plums. No other history was obtained tending to any suggestion of cause for her illness.

The mucous membrane showed patchy redness, and the gut contained thick brownish fluid; no flakes. Amongst dense masses of bacteria in this fluid, extremely fine, long, motile spirilla were conspicuous. Numerous cultivations of the fluid were made in peptone salt solution and in gelatine and agar plates, but no comma bacilli or vibrios were obtained. The microbe isolated was principally *proteus vulgaris*, which was present very abundantly; a few colonies only of *bacillus coli*.

Case XXV.—On September 7th, 1895, I received through Dr. Theodore Thomson a piece of ileum of a person who had died at Grimsby under symptoms strongly suspicious of Asiatic cholera. The history of this case, so far as could be learned, was this:—

> W. H., male, aged 55, was attacked with diarrhœa, vomiting, and pain (not located), on Saturday, August 31st. For three days these symptoms persisted, after which the diarrhœa ceased. Vomiting, however, contained, the vomited material being of a greenish colour. No information was forthcoming as to the appearance of the stools. The voice was whispering. The temperature was never observed to be above normal. The pulse, never rapid, was of fair strength in the

earlier stages of his illness, becoming, however, feeble in the last two days. Death ensued at 5 a.m. on Friday, September 6th, after an illness of about six days' duration.

Prior to the date of this attack, this person's health had been good.

No information was forthcoming tending to suggest a probable cause of his illness.

Of the sample of intestine submitted to me, the mucous membrane was deeply congested, and the cavity of the gut was filled with gelatinous material of a greenish colour, in which were numerous flakes. Examined under the microscope, the flakes appeared homogeneous masses, with few epithelial cells; in the hyaline matrix were crowds of short, straight rods, in *streaks and lines, and in small and large clusters.* There were no comma bacilli or vibrios recognisable. Peptone cultures of the material yielded only *proteus vulgaris;* the cultures in gelatine and agar plates proved that the above streaks of short bacilli were *proteus vulgaris* in a pure state.

Case XXVI.—On September 9th I received from Dr. Newby, of Grimsby, a fluid stool from a person affected with choleraic diarrhœa, with notes of the case as follows :—

The suspicious case mentioned in my telegram last night was in a man aged 21, an inmate of a common lodging-house in King Edward Road. He was taken about 2 a.m., 7th September, with profuse watery, flaky, vomiting and purging; also with severe cramp in legs and abdomen, which continued until I saw him, about noon. His temperature was then 97° F. in the mouth; surface cold, eyes sunken, voice husky, and pulse very feeble. He said he ate two apples and a couple of herrings the previous day, with scarcely any other food.

T. N.

Microscopic examination of the material submitted to me showed diffuse masses of bacteria, amongst which no comma bacilli or vibrios could be recognised; peptone salt cultures and gelatine and agar plates yielded chiefly colonies of *bacillus coli* and *proteus vulgaris.*

Case XXVII.—On September 9th I received a piece of ileum through Dr. Wrigley, of Great Yarmouth, with the following history :—

The patient, a woman aged 54, who had partaken of an oyster supper on Saturday, was attacked on Monday by rather acute diarrhœa. By Thursday, the looseness of her bowels ceased, and she seemed better; but on the following Monday morning she became collapsed; pulse at times imperceptible, and urine suppressed. She died at 9 p.m. the same day.

The intestine sent to me was much decomposed; cultivation of the material within it showed no commas or vibrios; *proteus vulgaris* only was obtained.

Case XXVIII.—On October 5th, 1895, I received through the Medical Officer of the London County Council a piece of ileum of a woman, J. T., æt. 57. Dr. Hamer has supplied the following notes of the case :—

Jemima T., wife of a tailor living at Amberley Road, Paddington. Death certified by E. Hibberd as due to "Choleraic diarrhœa five days, syncope."

I attended, with Dr. R. Dudfield, the post-mortem on 5th October, and obtained following history and noted following facts :—

Patient occupied ground floor of a house near the banks of the Regent's Canal. She had not been away from home. She had not

partaken of any food, so far as Dr. Dudfield could learn, which would have been likely to disagree with her.

On 28th September diarrhœa and vomiting commenced.

On 30th September her symptoms became aggravated. Cramps in abdomen, and also in legs. The stools were said to be like "orange water."

On 1st October, when seen by medical man, patient was collapsed, and she died on the following day.

Post-mortem.—Fairly nourished; small intestine, congested, nearly empty. Contents bile stained.

Gall bladder full of bile.

Heart, a patch of atheroma on one of flaps of mitral valve.

Liver only weighs 33 ounces.

Kidneys small, cortex narrowed, capsule rather adherent. Weight, 3¼ ounces and 3¼ ounces.

Bladder empty and contracted.

W. H. H.

The mucous membrane of the intestine sent to me showed patchy redness; within it was a small amount of thick yellowish fluid that did not contain flakes. Under the microscope there were seen crowds of bacteria in this fluid, but no commas or vibrios could be recognised. Cultivations in peptone salt solution and in gelatine and agar plates yielded chiefly colonies of *bacillus coli.*

Case XXIX.—On October 14th I received through Dr. Darra Mair, of the Croydon Rural District, a bottle containing the dejecta of a patient affected with choleraic diarrhœa, along with the following statement:—

> I have just had information of a case of acute choleraic diarrhœa in a woman at Mitcham, and I am forwarding a few ounces of some of the excreta which have just been sent to me, in order that there may be a bacteriological examination if thought advisable.
>
> I do not know much of the case, except that the medical attendant was called in late last night and found the patient collapsed, with sub-normal temperature; also vomiting and suffering constantly from cramps. There was no lividity. He apprehended a fatal result, but thinks this morning that reaction is setting in. I have had no information of any other cases of diarrhœa as yet, excepting in infants.
>
> L. W. D. M.

The dejecta in question were of fluid character, yellowish brown in colour. The material was crowded with bacteria, but neither by microscopic examination nor by culture in peptone salt solution and in gelatine or agar plates could any comma bacilli or vibrios be identified.

From the foregoing details it will be seen that neither in the dejecta nor in the intestinal contents of any of the 29 cases in England that were submitted to bacterioscopic test during 1894 and 1895, was anything discovered by microscopic or cultural examination that at all resembled the cholera vibrio. Some of the above cases, be it remembered, were in their onset, rapidity of course, and general clinical and pathological characters, so strikingly similar to Asiatic cholera that the medical attendants and medical officers of health made the provisional diagnosis of Asiatic cholera. Nevertheless, as I have said, in no single instance of a case of this description, however strong its resemblance to Asiatic cholera, could the cholera vibrio be detected by those methods in which in 1893 it could readily be identified. This result is of the greater importance in view of the fact that there had been no known importation of cholera into England from abroad during 1894 and 1895.

By way of contrast to the negative result quâ the cholera vibrio in all these cases, there is the striking circumstance that other cases occurring in August 1894 on board the SS. Balmore coming from an infected locality (St. Petersburg), and which were sent on arrival at the mouth of the Thames, to the Port Hospital by Dr. Collingridge, all, with a single exception, yielded by the peptone salt method of culture very readily the cholera vibrio, and notwithstanding that some of them seemed to be mere cases of diarrhœa.

Taking all these facts into consideration it is, I think, clear that none of the 29 cases I have recorded as occurring in England in 1894 and 1895, and which did *not* contain the cholera vibrio, were of the Asiatic type; that on the contrary it is proved that they were examples of cholera nostras. Their sporadic character alone does not of course prove this, since in 1893, when Asiatic cholera was present in England in some places in epidemic form, similar cases occurring sporadically in other localities yielded on microscopic and cultural examination very striking evidence of the presence of the cholera vibrio. In this connexion I cite the Westminster case, the Derby case, the Leicester case, and the Doncaster case, among others, in every one of which microscopic examination of the flakes of the rice-water contents of the intestine sufficed for diagnosis of true cholera, owing to the presence and peculiar distribution of the cholera vibrio in the flakes. Upon this view it follows that the absence of the cholera vibrio from a suspicious case, however similar its symptoms and pathology to that of Asiatic cholera, lends strong support to a conclusion that it is *not* a case of true cholera.

As regards certain of the 29 cases now in question, although bacillus coli, or proteus vulgaris, or both, were obtained from them by culture, these microbes were sometimes so much mixed up with other microbes that no special significance can be attached to their presence in the bowel contents. Such condition is indeed in no way different from what obtains in ordinary stools. But there were cases amongst the 29 which, as regards the number and the distribution of bacillus coli (or of proteus) differed from the others in very striking fashion. Those which I more particularly refer to were seven in number.* Of these cases the bowel contents (the bowel discharges in two instances) consisted of watery fluid in which floated more or less numerous mucus flakes containing leucocytes and detached epithelial cells;† physical conditions that are precisely similar to those observed in typical acute Asiatic cholera. And just as in Asiatic cholera, so also in the cases now in question, the flakes contained, in almost pure culture, one single species of bacterium, arranged in lines, in streaks, and in groups. The *sole* difference was that in Asiatic cases the bacteria thus arranged were the cholera vibrio, whereas in the above cases they were bacillus coli, or, in a single instance,‡ proteus vulgaris. In other of the 29 cases abundance of flakes and abundance of bacillus coli, or of proteus vulgaris, were demonstrated, though these bacteria were not in pure culture, and did not exhibit the "fish-in-stream" arrangement. These cases may be thought of as corresponding *quâ* English cholera to those cases of the Asiatic disease which in bacterioscopic respects are non-typical, *i.e.*, to cases in which the cholera vibrio although present is much mixed with other bacteria.

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* Case II. (Rowley Regis); Case IV. (Monk Bretton); Case VI. (Battersea); Case IX. (Grimsby); Case XIII. (Guy's Hospital); Case XV. (Rowley Regis); Case XXV. (Grimsby).

† In Cases XIII. and XV. the flakes contained leucocytes only.

‡ Case XV.

Now, if it be admitted that the presence in the intestine of the cholera vibrio in large numbers implies rapid production of toxic substances sufficing to cause the symptoms of cholera, it may well be that the presence in the bowel in enormous numbers of bacillus coli, or of proteus vulgaris, has similar toxic effect, provided that it can be shown that these microbes are capable also of producing toxic matters.

I have repeatedly had occasion to refer, in these reports, to the chemical activity of bacillus coli, and to mention that it is a powerful decomposer of albumen, a powerful producer of gas (methan gas), and a strong indol former. It can also be shown that it forms toxic substances; that is, substances which, injected into the animal body in sufficient amount, cause intoxication. This intoxication is known as sapraemia, and is characterised by fall of temperature, vomiting, purging, muscular twitchings, collapse, and death; post mortem there is found severe congestion of the intestine with watery contents. Thus, if a broth culture of bacillus coli, after incubation at 37° C. for four or five days, be sterilised (so that the enormous mass of bacilli coli that have developed in the medium are killed), and 2–3 c.c. of it be injected subcutaneously into a guinea-pig of about 250–300 grammes weight, it will produce the above symptoms and cause the death of the experimental animal. With proteus vulgaris, under like conditions, the result is equally striking; being the microbe of putrid decomposition par excellence, it is a strong producer of ptomaines. Introduction of this living microbe in sufficient quantity acts poisonously on rodents, causing acute septicæmic infection; and, similarly, injection of its metabolic products causes acute ptomaine poisoning with the symptoms above mentioned.

The presence, therefore, in the small intestine of the human subject of enormous numbers of bacillus coli or of proteus vulgaris cannot be regarded as matter of indifference. Under normal conditions neither of these microbes is present in the small intestine; at any rate they can, as a rule, only be obtained from the large intestine. Now, in the particular cases of English cholera that I have referred to, bacillus coli (once proteus vulgaris) was found in the small intestine in enormous number, and it is justifiable to assume that the metabolic products of such an enormous multiplication of the microbe could but be harmful to the body. The question, accordingly, resolves itself into this, how did such a number of bacilli (whether coli or proteus) get into the small intestine? As to this, many articles of food are exposed to contamination with either one or both these microbes, seeing that bacillus coli and proteus vulgaris are widely distributed and are present commonly in ordinary dust. If articles of food so contaminated are subjected to cooking or boiling, the microbes in them would thereby be killed; likewise they would most likely be killed by the acidity of the gastric fluid, both being sporeless microbes. But let this polluted food be uncooked food, or let there be a derangement of the stomach, whereby its natural acidity is impaired, then the passage of a large number of bacillus coli, or of proteus vulgaris, into the intestine might, owing to their enormous capacity of multiplication at body temperature, have acutely deleterious effects. This is a consideration that applies to, and has been constantly used with regard to, infection with the cholera vibrio. Let, it has been said, the cholera vibrio, for some reason or another, escape the action of the stomach and get in a living state into an unhealthy intestine, and it will then multiply with great rapidity and produce its toxic effects.

That, with regard to English cholera nostras, such a consideration is worthy of attention is well illustrated by the Case III. (page 177) which occurred at St. George's Hospital. The patient, æt. 50, had consumed

a quantity of "sour milk." Ordinary milk, such as is bought in many a shop in London, contains as a rule an abundance of bacillus coli; and if put aside it will rapidly "sour" and coagulate spontaneously owing to the multiplication of bacillus coli—this microbe having a powerful coagulating action on milk. In this case, then, the patient's intestine was the multiplying ground for a large amount of bacillus coli; the fluid contents of his small intestine showed the presence of numerous undigested milk-globules and crowds of bacillus coli. It is no exaggeration, therefore, to say that in this case the multiplication in the intestine of this microbe, with the elaboration there of its poisonous metabolic products, caused the acute choleraic symptoms.

The various samples of bacillus coli that were obtained from the different cases, notably those obtained from the Cases II., III., IV., VI., IX., XIII., and XV., were tested in each instance by a series of subcultures—as to gas production in ordinary gelatine shake cultures, as to coagulation of milk, and as to indol-production in broth cultures—and were found to be the typical bacillus coli. Also they were tested physiologically. Broth cultures were made and incubated for 24 hours at 37° C., and injected subcutaneonsly into guinea-pigs in the proportion of one cubic centimetre for each 300 grammes of body weight. All the animals became very ill in the course of a few hours; next day each had a big swelling at the seat of injection. In 48 hours some were found dead; others were still ill, each with big local tumour. In all, the bacillus coli was recovered by culture from the local tumour and from the heart's blood. Subcutaneous and intraperitoneal injection was also made of guinea-pigs with growth of the bacillus scraped from the surface of nutrient gelatine which had incubated for 48 hours at 20° C. And hereby it was ascertained that the above cultures acted certainly as virulently as similar cultures of the laboratory colon. In some cases (*e.g.*, Cases II., III., VI., IX.) bacillus coli obtained from the English cholera intestines was distinctly more virulent than the laboratory sample.

An interesting point observed in the stained film specimens made of some of the stools was the presence of fine spirilla-like objects. In some they were abundant; in others they occurred only sparingly. These "fine spirilla" take the stain only faintly, and have been repeatedly described in recent years as present also in cholera and diarrhœa stools by Abel, Aufrecht, and others. I, myself, in my cholera report for 1893 have mentioned them as detached or free flagella, and there is nothing in the publications of the above authors tending to show that they are anything but free flagella, which, owing to the presence in the stools of a mordant, have become accessible to the stain. In my examination of stools from cases of diarrhœa and English cholera, numerous such "fine faintly stained spirilla" have been repeatedly seen *still in connexion* with deeply stained bacilli (bacillus coli): figs. 4 and 5, plates I. and II., illustrate this point well. When one compares these preparations with film specimens from a pure culture of bacillus coli, stained expressly by Löffler's or Van Ermengem's method, in which as a rule numerous faintly stained detached flagella are met with—about which, of course, no question as to their nature can be raised—the similarity in appearance is striking. No one has yet succeeded in cultivating the above "fine faintly stained spirilla"; and if this were achieved it would still be necessary to explain why so many of them are found attached to bacilli. But until this is done, these free "fine spirilla" must be taken to denote detached flagella. One does, it is true, undoubtedly meet—occasionally, but rarely—in stools examined in the fresh state (in the hanging drop), with mobile spirilla. These,

however, both by their shape (corkscrew-like) and their mobility at once denote that they *are* spirilla. The above "faintly stained fine spirilla" are not, however, mobile, when seen free; moreover, their shape is not that of a true spirillum.

In bringing this report to a conclusion, I note the clinical and etiological aspects of an epidemic outbreak of severe diarrhœa which has appeared referable to a particular anaërobic sporogenous bacillus.

At the outset it is necessary to state, as will be presently shown more fully in Dr. Andrewes's report, that the cases of diarrhœa in this outbreak, although some were very severe in character, differed markedly in clinical respects from cases of English or of Asiatic cholera. Vomiting was absent, and all the cases ended in speedy recovery; moreover, the whole outbreak lasted only about 12 hours, that is to say, all cases set in within these 12 hours, and no further cases occurred later. The outbreak was referable to the consumption of a particular sample of milk, and as soon as its further use was stopped, no more cases appeared. Strictly speaking, then, this outbreak of diarrhœa is comparable to those wholesale attacks of diarrhœal illness due to food poisoning, of which the Medical Department had obtained a record through Dr. Ballard and others.

The history, course, and clinical character of the cases is described by Dr. Andrewes, the Health Officer of St. Bartholomew's Hospital, and I add here his report.

On the night of October 27th, 1895, a sudden outbreak of diarrhœa of a severe type occurred amongst the in-patients at St. Bartholomew's Hospital. The outbreak was a very sudden one: there had been no more diarrhœa for some days previously than commonly occurs in a hospital containing many different classes of cases. Medical and surgical wards were attacked alike, and out of 28 wards 15 were affected. The total number of cases during the night and the following morning was 59, including the slight cases; but there was noticed in addition a general tendency to looseness of the bowels amongst patients generally which could not be regarded as actual diarrhœa. The earliest cases occurred a little while before midnight, but the majority began about 2 a.m., and some as late as 5 or 6 a.m. Only the patients were affected; the sisters and nurses, with one exception, escaped altogether. The outbreak ceased as suddenly as it began, and by mid-day on October 28th, it was practically over; no new cases afterwards occurring, and the diarrhœa persisting only in very severe cases: one or two cases, however, relapsed as they were getting better.

The main features of the outbreak point clearly to the toxic character of some article of diet supplied to the patients alone, and the time of onset suggests supper, at 7 p.m., as the suspicious meal. It is possible to exclude with confidence the meat taken at the mid-day meal; not only from the length of time that had elapsed, but because amongst the cases there were those who had partaken indifferently of beef, rabbit, chicken, fish, or mince, while one very severe case was in a vegetarian. The articles of diet taken at supper were, in the majority of the cases, milk, boiled or unboiled, bread and butter, but some few cases had had beef-tea, and in one case no supper, as such, had been taken. Every person, however, attacked by the diarrhœa had recently partaken of milk. No difference had been observed in any ward in the milk, the butter, or the bread supplied: all appeared of the customary good quality. October 27th was a Sunday, on which day there is no afternoon delivery of milk, so that the milk taken at supper had been standing since mid-day in the wards or kitchens, but it had not turned sour or acquired any unusual flavour. No difference was observed whether boiled or unboiled milk had been used, but this fact cannot exclude the milk as a source of infection since the organism found by Dr. Klein in the stools was a spore-bearing bacillus.

A sample of milk taken from the same source as that supplied on October 27th was furnished, by the company supplying the hospital, on October

30th, and submitted to bacteriological examination. A sample of the actual butter supplied to the wards on October 27th was also examined bacteriologically but with no result: nothing abnormal was found in it.

From the sample of milk, however, furnished on October 30th, the same peculiar organism was isolated which was found in all the stools examined. This fact, together with the absence of any evidence incriminating any other article of diet, renders it highly probable that the milk was the agent of infection.

Inquiry into the source of the milk of the company which supplied it elicited the facts that on Sunday, October 27th, 17 gallons out of a total of 190 gallons came from a certain farm at Melton Mowbray, and that the sample furnished on October 30th was from the same farm. This milk had not been delivered to the hospital since, but had been supplied, both before and since the outbreak of diarrhœa, to other customers without producing any harmful effect so far as the company's knowledge went. It is, however, to be noted that when the churn, from which the sample of October 30th was taken, was brought to the hospital, both the man who brought it and the hospital cook, observed that it was not of the usual good quality, and it was not taken in and used for consumption: a sample only was taken for bacteriological analysis.

On the supposition that the milk was the cause of the diarrhœa outbreak, the irregular and capricious distribution of the disease in the hospital need excite no surprise, for the manner in which the milk was sent out to the different wards would well explain it. It was poured through a strainer into a wooden tub, from which the ward vessels were filled, and this tub was never allowed to get empty, but a fresh churn was poured in when it got low, thus leading to an irregular mixture of the milk from one churn with that from the others.

Clinical Characters of the Outbreak.—The earliest symptom in nearly all cases was abdominal pain, often of a severe character. This was followed in the course of half-an-hour or more by diarrhœa. Vomiting was conspicuously absent in the great majority of the cases, though present in a few severe ones in their later stages: the disorder was intestinal and not gastro-intestinal. In some instances the bowels were open six or eight times in the course of 12 hours, but in the majority of cases only two or three times. The stools were in most cases liquid and watery, and a considerable amount of mucus was present in every case into which special inquiry was made. They were usually of a light brownish yellow colour—described in some instances as resembling typhoid stools; in the more severe cases streaks of blood were present, and in exceptional cases blood in larger amount. In most cases the stools were described as exceedingly offensive in odour—but this was not always so. In all but the slight cases a considerable degree of prostration occurred, and in some of the worst cases this was considerable, the patients becoming collapsed, with cold extremities and very feeble pulses. But in no case was the attack fatal, even when the patient had been previously suffering from severe disease.

As a rule the attack ceased in the course of 12 hours, or soon yielded to simple treatment, the patients quickly recovering their normal condition. In some of the severe cases the diarrhœa persisted for two or three days, and in one or two instances relapses occurred as the patients were improving. In no case did the complaint last more than four or five days.

The following abstract of six of the more severe and typical cases, including those the stools of which were submitted to bacteriological investigation, will give an idea of the clinical characters of the attack.

Case I.—Isabella M., age 32. Admitted on October 4th for burns. She had quite recovered from the shock, and the burns were healing, but she was still in bed. On the night of October 27th, between midnight and 1 o'clock she was seized with severe abdominal pain, followed by diarrhœa which persisted for 48 hours. The stools were scanty, dark in colour (she was taking iron), very offensive, and contained much mucus and a little blood. The bowels were open twice during the night of the 27th, six times during the 28th, three times

during the night of the 28th, four times during the morning of the 29th, and once on the night of the 29th. The attack was then over. There was no vomiting at the onset, but she vomited several times on the 28th and once early on the 29th. She became collapsed and cold during the night of the 27th; and this condition was marked on the 28th, the pulse becoming almost imperceptible. There was no relapse, and she made a good and rapid recovery.

Case II.—Charles H., age 46. Originally admitted for cellulitis, and had had several incisions made for abscesses in the thigh and foot, but had almost recovered. At 1 a.m. on the night of October 27th he was seized with severe abdominal pain followed by diarrhœa. The stools were fairly copious, light in colour like typhoid stools, and were very offensive; they contained no mucus and no blood. The bowels were open three times during the night of the 27th, five times during the 28th, five times during the night of the 28th, six times during the 29th, and twice during the night of the 29th. The attack then stopped. There was no vomiting, and no definite collapse, though he became very cold during the night of the 27th. He recovered rapidly.

Case III.—Sarah Ann E., age 19. Suffering from double mitral disease and adherent pericardium, with a very irregular pulse and an enlarged liver. She had been improving and had been allowed to get up. Having been very constipated, she was given a drachm of compound liquorice powder about 4 p.m. on October 26th, the result of which was several free actions of the bowels on the night of the 26th and on the 27th. On the night of the 27th the bowels were again open three times, but there was no pain and no vomiting; the stools were loosely formed, light brown in colour, and contained mucus but no blood; some consisted of little but mucus. On the 28th she was still passing loosely formed stools. On the 29th there was a severe relapse of diarrhœa, with very severe abdominal pain and some vomiting. The bowels were opened three times during the day and four times during the night of the 29th, the stools being now of a darker brown colour, containing mucus and streaks of blood. The pain, vomiting, and diarrhœa continued during the 30th and 31st; she passed small stools containing mucus and a little blood, and became prostrate and collapsed, passing very little urine, and having a very feeble pulse. There was a slight rise of temperature, but this was probably attributable to some rheumatic symptoms which were present at the same time. After the 31st the diarrhœa ceased and she soon resumed her accustomed state of health.

Case IV.—Edward B., age 59; had been admitted for empyema, and had later developed symptoms of phthisis. His bowels were habitually open regularly once a day. At 11 p.m. on the night of October 27th he was taken with severe pain in the abdomen followed by diarrhœa; the bowels were opened about eight times during the night, the stools being light brownish yellow, very loose and watery, but not offensive; the later stools contained mucus, but no blood was present. There was no vomiting. On the morning of the 28th he was prostrate and somewhat collapsed. The diarrhœa continued during the 28th, but ceased during the following night; the pain was still severe on the evening of the 28th, and indeed persisted till midday of the 29th, after the diarrhœa had ceased. There was no rise of temperature.

This case was fairly typical of the numerous cases, 11 in all, which occurred in this ward. All had abdominal pain, and all passed loose watery stools of a yellowish brown colour, containing mucus but no blood, and not particularly offensive in odour.

Case V.—M. Amie L., age 31. A vegetarian. She was suffering from ankylosis of the left knee-joint, and had had no preceding diarrhœa. At 12.30 on the night of October 27th she was seized with severe abdominal pain followed in half an hour by diarrhœa, but no

vomiting. The bowels were opened six times in the first 24 hours, and four times in the succeeding 24 hours; the stools were light-coloured, offensive in odour, and contained much mucus and a little blood. There was no collapse, and nothing that could even be called prostration. The pain ceased before the diarrhœa, the pain being over about 11 a.m. on the 28th and the diarrhœa stopping the same evening.

Case VI.—Jane C., age 29. Suffering from fractured tibia and fibula. She was attacked on the evening of October 27th, rather earlier than the great majority of the cases, about 8 p.m. The abdominal pain was rather severe but there was no vomiting. The bowels were opened seven times in the night, seven times in the next 24 hours, and four times on the 29th, after which the attack ceased. The stools resembled those of the preceding case. There was no prostration or collapse.

On examining specimens of the evacuations under the microscope, they were found to contain numerous red and white blood corpuscles and crowds of bacteria. Amongst these a very large number of oval glistening spores attracted attention. These spores were either free, isolated or in continuous masses, or they were contained within cylindrical bacilli, each of which contained one spore near to one end. These spores and spore-bearing bacilli were found abundantly in every one of the evacuations that were examined. As the occurrence of such an abundance of spores and spore-bearing bacilli in the human intestine is an unusual circumstance, special attention was directed to them, and cultivations were made to isolate the microbe. In doing this the only two known species of spore-forming bacilli in the intestine that had to be considered were (1) the *Bacillus mesentericus*, and (2) the *Bacillus amylobacter*. The last-named could be at once excluded, from the fact that in the above microscopic specimens no clostridia could be discovered, *bacillus amylobacter* being noted for the clostridia forms of its sporing bacilli. The first species, viz., *bacillus mesentericus* could, with probability, be excluded as a result of the microscopic examination of fresh specimens alone, since its bacilli show conspicuous motility, whereas the motility of the bacilli in question was extremely feeble, and could be recognised only in very few examples. But the culture test soon proved that the spores of the bacillus under notice were not those of *bacillus mesentericus:* Aërobic gelatine and agar plates, and surface cultures on gelatine and agar, brought forth colonies of *bacillus coli* only. *Bacillus mesentericus* being aërobic, if it had been present in the evacuations, should undoubtedly have made its appearance in these cultures. More direct proof, however, of the absence of this microbe was obtained by placing a flake of evacuation in gelatine or agar, heating the medium to 78–80° C. for 10–15 minutes, and then preparing ordinary aërobic plates of the media and incubating them at 20° and 37° C. respectively: No colonies of any description made their appearance. The spores of *bacillus mesentericus*, like other well-known spores (of *bacillus subtilis*, of *bacillus anthracis*, of the microbes of tetanus, of quarter evil, of malignant œdema, &c.), when heated to 80° C. for 10 or 15 minutes do not lose their power of subsequent germination, although all non-sporing bacilli, *e.g.*, *bacillus coli*, are thereby killed. Since, then, in the aërobic plates of the heated gelatine and agar no growth took place, there could not have been any spores of *bacillus mesentericus* present. Next, anaërobic cultures were made of the evacuations; a flake was placed deep in grape-sugar gelatine and in grape-sugar agar, heated to 78–80° C. for 10–15 minutes, then allowed to set, sealed, and incubated.

In both the sugar gelatine and the sugar agar cultures already after 24 hours numerous colonies were noticeable in the depth. Those in the sugar gelatine were spherical translucent masses of liquefied gelatine, those in the sugar agar small whitish dots not liquefying the agar. At the same time gas bubbles were present in connexion with the colonies, particularly in the sugar agar. After 48 hours the growth had so advanced, and the liquefaction of the gelatine had become so extensive, that the lower half of the medium in the test tube was completely liquefied, and made very slightly turbid by the growth. Meanwhile on the surface of the liquefied growth gas bubbles were sometimes present, sometimes altogether absent; in the depth there were whitish cloudy flakes.

Examining under the microscope such a liquefied gelatine culture after two or three days' growth, it was found to be made up of rod-shaped or cylindrical bacilli, occurring singly or in chains of two, three, or more rods. These were mostly apparently stationary, but here and there feeble locomotion could be noticed, consisting in a wobbling or rolling slightly progressive movement. In some of the bacilli there was present a bright oval spore, occasionally in the middle, but oftener near one end. In the floccular masses at the bottom of the culture tube spore-bearing bacilli were numerous, and even occasionally a free spore. After three or at latest after four days the whole of the sugar gelatine in the tube had become liquefied by the growth; on the top there were gas bubbles, in the depth a white powdery precipitate which on microscopic examination showed numerous free spores. When such a culture tube is opened it gives a distinct smell of butyric acid. When the liquefied gelatine is disturbed by moving in it a platinum or glass rod, numerous gas bubbles rise up; and the liquid when sucked up in a capillary pipette emits a considerable amount of gas bubbles. When the culture tubes are exposed to the light, numerous gas bubbles rise up and collect on the surface.

A large number of sub-cultures in various media were made from the primary anaërobic sugar gelatine cultures, and of the results thus obtainable the following deserve special mention.

(*a*.) The rapidity of liquefaction of the sugar gelatine by the growth stands in an inverse ratio to the amount of gas bubbles escaping through the gelatine as the growth proceeds. If, after inoculation of the sugar gelatine by stab, there are found, after one or two days' incubation, numerous gas bubbles distributed in the upper part of the gelatine and escaping to the free surface, it may be predicted with certainty that the growth in, and the liquefaction of, the gelatine in such a culture will proceed very slowly; and conversely, if after one or two days' incubation the progress of liquefaction in the depth (after inoculation of the depth) is conspicuous, there will be very little or nothing to be seen of gas bubbles on the surface.

(*b*.) The formation of spores stands in direct relation to the rapidity of liquefaction; in tubes in which the growth and the liquefaction proceed very slowly, there are at no time spores formed in the bacilli. In old cultures of this kind the bacilli are found as longer or shorter threads, some undergoing involution and death by granular disintegration. On the other hand, in tubes in which liquefaction proceeds rapidly—the whole of the gelatine becoming liquefied in two to three days—there is always copious spore formation.

(*c*.) Milk inoculated with the bacillus and incubated at 37° C. shows, as a rule, in 24 hours, sometimes not quite so soon, distinct changes consisting in the separation of flocculi of coagulated caseïn from the slightly turbid whey, numerous gas bubbles being present in the creamy layer on the surface. After 48 hours the separation is

complete, most of the caseïn flocculi are on the surface mixed with numerous gas bubbles, the cream being so altered that only a thin layer of fluid yellow oil is present on the surface of the culture. Examined under the microscope, the clear whey is full of short cylindrical bacilli. Spore formation in milk cultures is observed in the laboratory only when the culture is made anaërobically and when there is no marked spontaneous evolution of gas bubbles; under these conditions, whitish cloudy flocculi are found in the whey, which are full of spores.

(*d.*) The spores do not lose their power to germinate if exposed to 80° C. for 15 minutes; they are, however, killed if immersed in boiling water for two minutes.

(*e.*) The cultures in gelatine, as also in milk, have a distinct smell of butyric acid. This is more pronounced the older the culture.

Cultures in sugar gelatine, as also cultures in milk, while young (not more than a week old) when injected into the subcutaneous tissue of guinea-pigs or mice prove virulent. Half to one cubic centimetre of the liquefied gelatine culture, or of the whey of a milk-culture, per 150–200 grammes body-weight of guinea-pig, causes, when injected under the skin of the groin, distinct illness in six to eight hours. The animals are quiet, do not feed, they have œdematous swelling about the seat of injection, and the body temperature is lower than normal; their muscular movements become gradually greatly impaired, and they are found dead in 20 to 24 hours. Smaller quantities produce the fatal result in two, or perhaps three, days; very small quantities cause only temporary illness and transitory local swelling. On post-mortem examination, the subcutaneous and the muscular tissues of the groin, of the whole of the abdomen and chest, and even of the neck, are found deeply congested, separated from the skin by accumulations of gas; and the tissues are infiltrated with copious sanguineous malodorous exudation. This, under the microscope, is densely filled with rod-shaped or cylindrical bacilli; few of them motile, most of them without motility. While the local appearances produced in the guinea-pig by injection of cultures of the microbe bear a considerable general resemblance to those produced by injection of Koch's bacillus of malignant œdema, which, as is well known, is also an anaërobic microbe, there exist marked differences between the two: In malignant œdema the sanguineous exudation contains, besides cylindrical bacilli, numerous characteristic, thread-like bacilli, whereas in guinea-pigs inoculated with this anaërobic bacillus these threads are quite absent; besides, the bacilli of malignant œdema are generally longer than in the present instance; and in malignant œdema most of the bacilli are actively motile, whereas in the case of this anaërobic microbe very few are motile, and these only feebly so. A further difference is brought out by the examination of microscopic specimens, both of the cultures and of the subcutaneous exudation, in which the bacilli have been submitted to the process of staining after Gram's method. While the bacillus of malignant œdema, after staining by Gram's method, is decolorised, this anaërobic bacillus retains the dye well. The bacillus of malignant œdema does not cause rapid curdling of milk, as this anaërobic bacillus does.

Another noteworthy difference between the two microbes is in their liquefaction of sugar gelatine in anaërobic cultures. Although the colonies in sugar gelatine look alike for both these microbes, this diarrhœa bacillus liquefies the gelatine conspicuously faster than the bacillus of malignant œdema, and the gelatine liquefied by the former is less turbid than that by the latter. Also, in respect of flagella, a marked difference is noticed between the two microbes. The bacillus of malignant œdema possesses

numerous flagella fastened along its cylindrical body, this diarrhœa bacillus possesses flagella only near the rounded ends. Thus, short rods possess, as a rule, flagella at both ends, one, two, or three at one, a bundle of three to eight at the other end; the flagella, moreover, are always attached at one point laterally to the rounded end. The cylindrical bacilli have one to three flagella at one end only. Some of the flagella are very long—six to ten times the length of the bacillus—and spiral, others are shorter and wavy. In a preparation in which the flagella are successfully stained (by Van Ermengem's modification of Löffler's method), besides those that are still attached to the bacilli there are numerous flagella—single or in bundles, wavy or spiral—which are free, that is, which had become detached during the process of preparation. It is certainly very surprising, in view of the extremely feeble motility shown by a few only in the fresh state, to find in such specimens that a large number of bacilli do possess numbers of long spiral flagella; from a flagella-stained specimen one would conclude that the majority of the bacilli are possessed of brisk motility, such a conclusion is, however, very conspicuously contradicted by actual observation.

A further difference between the bacillus now in question and that of malignant œdema is the distribution and morphology of the microbe in the infected animal. Thus, while in animals that succumb after infection with the malignant œdema bacillus, numerous bacilli are present in the spleen, many of them as characteristic threads, in the case of this diarrhœa bacillus the spleen contains the microbe very sparingly, and then only as short rods. An appreciable amount of spleen tissue has to be used for obtaining successful cultures, and the same applies to the blood of the circulation. But in the size and the position of the spores in the bacilli, this anaërobic bacillus closely resembles the bacillus of malignant œdema. As in the case of the bacillus of malignant œdema so also with this bacillus, larger doses of culture are required for infection of guinea-pigs than of the subcutaneous exudation; this latter on subcutaneous injection proving more virulent than the artificial culture. In the case of this anaërobic bacillus, subcutaneous injection of five minims of the subcutaneous exudation suffices to produce fatal result within 20 to 24 hours in a guinea-pig of 200 grammes weight.

Spores alone, or cultures five to seven days' old in which spore formation is nearly completed, do not act as virulently as young cultures when injected subcutaneously into the guinea-pig; large doses of the former being required to produce the same result as small doses of the latter. Doses which, taken from recent cultures, produce fatal results in 20 to 24 hours, when taken from old cultures full of spores produce only a transitory local swelling and transitory constitutional disturbance. Neither mice nor guinea-pigs are susceptible to infection by feeding with the spores.

Injected into the peritoneal cavity of the guinea-pig the bacilli of young cultures produce fatal results in six to eight hours; the peritoneal cavity containing after death copious sanguineous exudation full of the bacilli.

		μ.
The size of the bacilli is, length	- - -	1·6 to 4·8
" " thickness	- - -	0·8
" *free* spores is, length	- -	1·6
" " thickness	- -	0·8 to 1

In size, shape, feeble motility, in the rapid liquefaction of sugar gelatine, in the characteristic changes produced in milk, this bacillus

resembles the anaërobic *bacillus butyricus* described by Botkin,* but Botkin's bacillus differs from this microbe in the character and aspect, in gelatine and agar, of its young colonies (which are filamentous), and in not being pathogenic. This diarrhœal organism is as strongly pathogenic as that of malignant œdema, from which, however, as pointed out above, it differs, both morphologically and culturally, in several important points; I therefore propose to call it by a separate name, *bacillus enteritidis sporogenes.*

A sample of milk from same source as that delivered at the hospital on Sunday morning (October 27th), and mentioned in Dr. Andrewes's report as the only article that was partaken of by all those attacked by the disease, was subjected to bacterioscopic examination. It was contained in a pint bottle and was decanted into sterile test tubes. These were heated to 78 to 80° C. for 10 to 15 minutes, and then placed in the incubator at 37° C. The changes that occurred in these milk samples were precisely the same as described above of milk inoculated from cultures of *bacillus enteritidis.* The microscopic examination also revealed the same bacilli and, later on, their spore formation. From these primary cultures of the hospital milk anaërobic subcultures were made in grape-sugar gelatine and in fresh sterilised milk, and with these subcultures inoculations into guinea-pigs were made; the results, as to the morphological, cultural, and pathogenic characters, were precisely the same as those obtained with the cultures of the *bacillus enteritidis* from the evacuations of the diarrhœa cases.

It is, therefore, proved that the particular samples of the hospital milk, as also the evacuations of the persons attacked by diarrhœa at the hospital, contained the same uncommon pathogenic anaërobic spore-bearing bacillus. In the patients' evacuations its spores, as we have seen, were present in enormous numbers, and the conclusion seems justified that, taken in with the milk, the spores had germinated in the alimentary canal, and that the bacilli derived therefrom had rapidly multiplied, and ultimately again produced the spores which were found so abundantly in the bowel discharges. The ability of the microbe to produce sanguineous exudation in the subcutaneous tissue of the guinea-pig suggests that in the alimentary canal also of the infected persons it had caused the sanguineous exudation passed out as fluid blood-streaked evacuations.

* Botkin, "Ueber einen *Bacillus butyricus*," "Zeitschrift f. Hygiene u. Infectionskrank," Bd. xi., p. 421.

PLATE I.

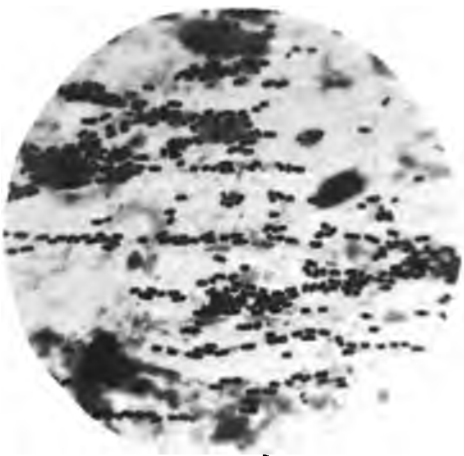

FIG. 1.

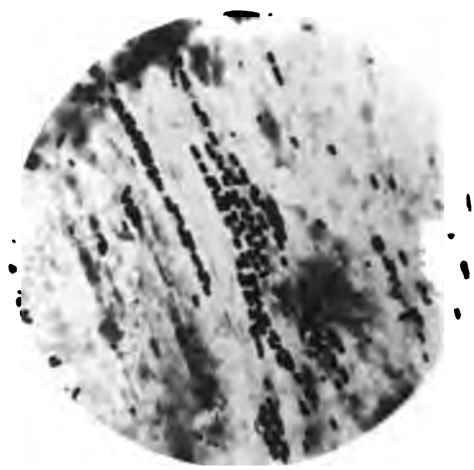

FIG. 2.

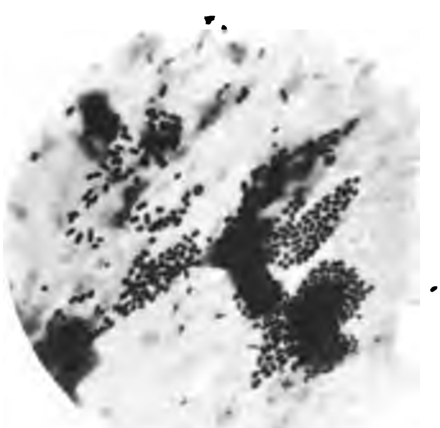

FIG. 3.

FIG. 4.

ENGLISH CHOLERA AND DIARRHŒA.

PLATE I.

FIG. 1.

Film specimen of a flake from the contents of the ileum of Case No. II. (Rowley Regis, page 177), showing *bacillus coli* in pure culture distributed in rows and streaks— the "fish-in-stream" arrangement.

FIG. 2.

Film specimen of a flake from the contents of the ileum of Case No. XXI. (Newington, page 189), showing *bacillus coli* in pure culture and distributed as in the preceding figure.

FIG. 3.

Film specimen of a flake from the contents of the ileum of Case No. IV. (Monk Bretton, page 178), showing groups of *bacillus coli* in pure culture.

FIG. 4.

Film specimen from the contents of the ileum of Case No. XXVIII. (Paddington, page 192), showing *bacillus coli* with flagellum.

[Magnifying power, in each instance, 1,000.]

ENGLISH CHOLERA AND DIARRHŒA.

PLATE II.

FIG. 5.

Film specimen from the contents of the ileum of the same case as Fig 4; *bacillus coli*, some individuals exhibiting a flagellum.

FIGS. 6 and 7.

Film specimens of flakes from the bowel discharges in a case of acute diarrhœa. Many spirilla are here seen, some of them, possibly, flagella detached from *bacillus coli*.

FIG. 8.

Film specimen of a flake from the bowel discharge of a person suffering from epidemic diarrhœa in St. Bartholomew's Hospital, October 1895, showing numbers of *bacillus enteritidis sporogenes*, some of which are thick and exhibit spores in their interior; also a free spore.

PLATE II.

Fig. 5.

Fig. 6.

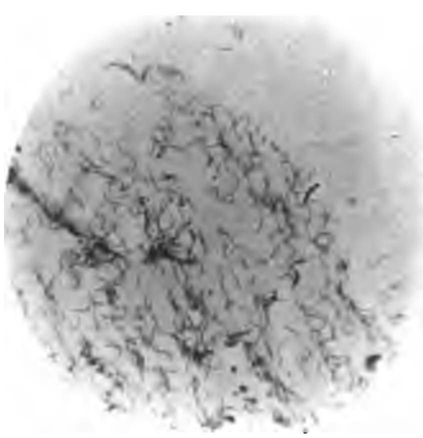

Fig. 7.

Fig. 8.

PLATE III.

Fig 9.

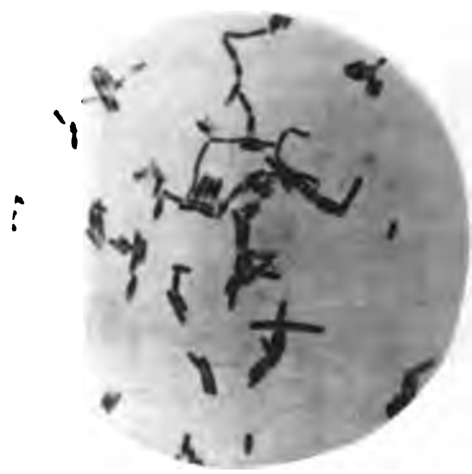

Fig. 10.

Fig. 11.

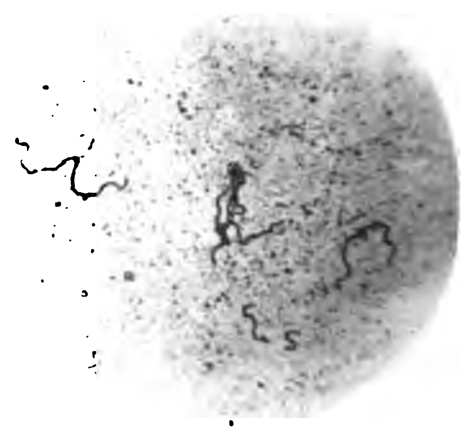

Fig. 12.

ENGLISH CHOLERA AND DIARRHŒA.

PLATE III.

FIG. 9.

Film specimen, stained after Gram's method, of exudation in the areolar tissue of a guinea-pig which died as the result of subcutaneous injection with culture of *bacillus enteritidis sporogenes.* The bacillus that was injected is here seen in pure culture.

FIG. 10.

Film specimen of a sugar-gelatine culture of *bacillus enteritidis sporogenes* that had been grown for *three* days at 20° C. Many of the bacilli depicted here are seen to contain a centrally placed, oblong, deeply stained spore.

FIG. 11.

Film specimen of the spleen pulp of a guinea-pig which died as a result of subcutaneous injection with culture of *bacillus enteritidis sporogenes.* A few of the bacilli are seen among the tissue nuclei.

FIG. 12.

Bacillus enteritidis sporogenes, stained after Van Ermengem's method and showing its flagella; also some free flagella.

[Magnifying power, in each instance, 1,000.]

ENGLISH CHOLERA AND DIARRHŒA.

PLATE IV.

FIGS. 13 and 14.

Specimens of *bacillus enteriditis sporogenes*, exhibiting the bundle of long flagellas attached to one end of the microbe.

FIG. 15.

Film specimen of the peritoneal exudation in a guinea-pig which died *eight hours* subsequent to intraperitoneal injection with culture of *bacillus enteriditis sporogenes*. Numerous bacilli of this species with square-cut ends.

FIG. 16.

Film specimen from a like source to that referred to under Fig. 15, showing the swollen sheath of a degenerated chain of *bacillus enteriditis sporogenes*.

[Magnifying power, 1,000.]

PLATE IV.

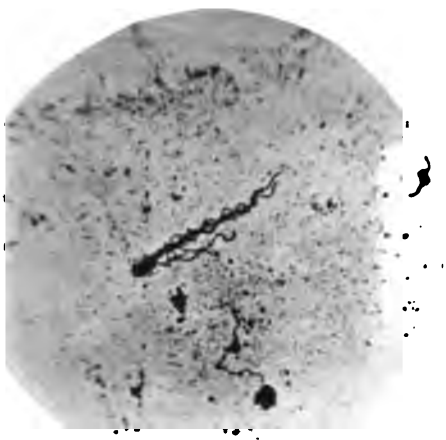

FIG. 13.

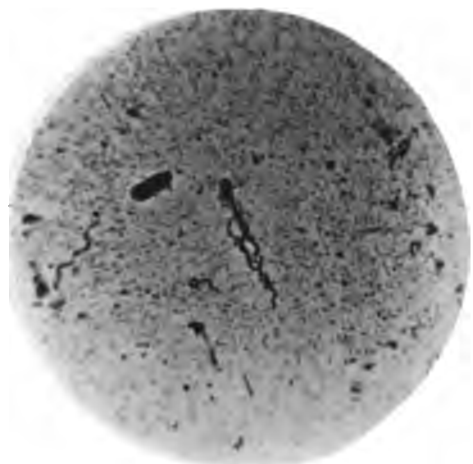

FIG. 14.

FIG. 15.

FIG. 16.

PLATE V.

FIG. 17.

FIG. 18.

FIG. 19.

FIG. 20.

ENGLISH CHOLERA AND DIARRHŒA.

PLATE VI.

FIG. 21.

A stab-culture in sugar-gelatine of *bacillus enteritidis*, after *forty-eight hours'* incubation. Liquefaction is advanced; at the upper part of the growth there is a gas bubble at the lower part a floccular mass of spores.

FIG. 22.

The same stab-culture after *three days'* incubation. Liquefaction has involved the whole of the culture medium; at its upper part are gas bubbles, lower down are voluminous masses of flocculi full of spores.

FIG. 23.

Sugar-gelatine inoculated, anaërobically, by stab-culture with the heart-blood of a guinea-pig which died as the result of subcutaneous inoculation with *bacillus enteritidis*. The culture, though *several weeks* old, shows comparatively little growth, liquefaction, or spore containing flocculi. It exhibits, however, copious gas formation.

[The figures in each instance are natural size.]

PLATE VI.

FIG. 21.

FIG. 22.

FIG 23.

No. 2.

FURTHER REPORT ON PROPHYLAXIS IN DIPHTHERIA; by Dr. KLEIN, F.R.S.

APP. B. No. 2.

On Prophylaxis in Diphtheria; by Dr. Klein.

In my report on this subject last year I showed that trustworthy anti-toxic serum is obtainable by repeated injection of the horse with living culture of the diphtheria bacillus as well as by (the continental method) successive injections in increasing amount of the toxin elaborated by this microbe. Further, comparing the two methods, I pointed out that while a serum of high degree of germicidal potency is incomparably more quickly obtained by the former than by the latter process, injection of the horse with the living culture of diphtheria bacillus does not furnish a serum so stable at a high level of inhibitory potency as does injection of the toxin.

That injection of the living culture, where the object is to produce in the blood and tissues of the experimental animal a germicidal agent inhibitory of the diphtheria bacillus, should prove superior to injection of mere toxin was to be expected, since in similar way, in all probability, is immunity acquired by the animal body under ordinary conditions in nature. Immunity—*i.e.*, the power to resist a second infection—is, in most instances, under natural conditions, a result of the growth and multiplication of the specific microbe within the infected body. And, elsewhere, I have shown that the germicidal power of the blood (as distinguished from its ability to neutralise toxin) in acquired immunity must be thought of as derived from the bacillary bodies of the infecting microbes. Viewed from this point, diphtheria serum obtained by repeated injection of the horse with *living diphtheria culture* may be expected to contain germicidal or anti-microbic substances in a larger measure than diphtheria serum obtained by injecting solely the metabolic products of the diphtheria microbe. To put this proposition to the test of actual experiment, a series of comparative studies have been made of diphtheria serum of one and the other kind. As representing diphtheria serum of the germicidal class I used the serum of a horse which I had subjected to repeated injections with living culture, the other and toxin-neutralising class of serum was represented in my experiments by diphtheria serums prepared respectively by Behring and Aronson, and, as well, by a serum prepared by the British Institute of Preventive Medicine, which adopts in this matter the method practised by Roux. In what follows these different serums will be referred to as—No. 1, Behring's; No. 2, Aronson's; No. 3, Roux's; and No. 4 my own preparation of serum.

Behring's serum is described as containing 600 units of immunising strength in 7·5 c.c.; that is to say, about $\frac{1}{800}$ of a c.c. of the serum is capable of neutralising, in a guinea-pig of 200–300 grammes weight, tenfold a minimal fatal dose of pure toxin. Aronson's serum, tested in the same way, was found to possess only half of the strength of Behring's, and

the serum of the British Institute was found of about the same potency as Aronson's. The serum of my own manufacture tested against pure toxin was found also to be of the strength of Aronson's serum.

The experiments now to be described were made in order to ascertain the comparative strength of these different serums as germicidal agents, when used in regard of animals injected in each instance with a minimal fatal dose of living culture of diphtheria bacillus. The diphtheria cultures employed were living broth cultures grown for 48 hours at 37° C., and living gelatine culture grown for 8 to 14 days—generally 12 days—at 20–21° C. The latter were always so prepared that a gelatine surface (in a tube) 6 centimetres long, 2 centimetres wide, was inoculated in three streaks by means of an infected platinum loop. After 8 to 14 days incubation, each such streak was a thick, white, dry band, several millimetres broad, with irregular knobbed margin. At this stage, after the addition to the tube of a definite quantity of sterile bouillon, the growth was completely detached from the surface of the gelatine by means of a sterile platinum loop, and well shaken up in the bouillon. I have found by many experiments that the virulence of a diphtheria gelatine culture so distributed in bouillon is by far more constant and uniform than similar distribution of agar culture however recent, and certainly far more trustworthy than a broth culture 48 hours old. In using a broth culture for injection it has to be remembered, too, that in addition to the living diphtheria microbes a good deal of the diphtheria toxin must needs be introduced. This is not the case with gelatine surface cultures; at any rate these can only afford toxin in very minute quantities, which is of importance when the question is one of determining the germicidal action only of the serum.

Series I.

In this and the next series a definite quantity of serum was, in each instance, mixed in a watch glass with a definite quantity of a *broth* culture (48 hours old) of diphtheria bacillus, and injected subcutaneously into a guinea-pig.

No. 1. Guinea-pigs *a* and *b* each received 0·5 c.c. of the broth culture mixed with 0·01 c.c. of Behring's serum.

No. 2. Guinea-pigs *c* and *d* each received 0·5 c.c. of the broth culture mixed with 0·01 c.c. of Aronson's serum.

No. 3. Guinea-pigs *e* and *f* each received 0·5 c.c. of the broth culture mixed with 0·01 c.c. of serum prepared after Roux's method.

No. 4. Guinea-pigs *g* and *h* each received 0·5 c.c. of the broth culture mixed with 0·01 c.c. of my own serum.

An additional, and "control," guinea-pig received 0·5 c.c. of the broth culture only.

All the nine guinea-pigs were of about the same body weight, *i.e.*, 180–200 grammes.

The result was this: the "control" animal had next morning a conspicuous local tumour, and was found dead in 36 hours.

No. 1. Guinea-pigs *a* and *b* had no local swelling next day and were both lively; but by the end of a week both had developed big tumours, and on the thirteenth day were found dead.

No. 2. Both guinea-pigs *c* and *d* had big swellings next day. One was found dead in 36 hours; the other was then ill, and died during the third day.

No. 2. Guinea-pigs *c* and *d* each received $\frac{1}{10}$th of the gelatine culture and 0·01 c.c. of Aronson's serum.

No. 3. Guinea-pigs *e* and *f* each received $\frac{1}{10}$th of the gelatine culture and 0·01 c.c. of the "Roux" serum.

No. 4. Guinea-pigs *g* and *h* each received $\frac{1}{10}$th of the gelatine culture and 0·01 c.c. of my own serum.

One control animal received $\frac{1}{10}$th of the gelatine culture only.

The result was that all the above animals, except two, behaved like the control animal, viz., had good tumour next day and were dead in 36 hours. The exceptions were animals *e* and *h* (experiments 3 and 4); these exhibited in each instance slight local tumour, but survived.

Series IV.

This series was carried out exactly as Series III., but five times the amount of serum, *i.e.*, 0·05 c.c., was mixed in each instance with $\frac{1}{10}$th of a gelatine culture. The body weight of the guinea-pigs was about the same as in Series III.

The result was also unsatisfactory. All animals had tumour next day. Of the two Behring's animals one died, like the control animal, *i.e.*, in 36 hours; the other had ulceration of the tumour, and gradually wasted and died after three weeks. The two Aronson animals both died; one on the fourth the other on the ninth day. The two "Roux" animals had tumour, but remained alive though the tumours ulcerated. The guinea-pigs treated with my own serum had tumour; in one ulceration set in, and the animal wasted and died after a month; the other had no ulceration, its tumour disappeared and the animal remained well.

Series V.

This series differed from the former only in the circumstance of a further increase in the dose of serum, viz., to 0·1 c.c. The body weight of the guinea-pigs was about the same as in Series III.

The result was more satisfactory. The control animal was the only one that died, in 36 hours; all the others remained alive. The two Behring animals, the two "Roux" animals, and the two treated with my serum remained without tumour. One of the Aronson animals had slight tumour, which had disappeared in four days.

From these several series of experiments it will be seen that $\frac{1}{10}$th of a gelatine culture was not inhibited *in corpore* as readily as broth culture; 0·05 c.c. of serum had a more distinct action when broth culture than when gelatine culture was used. At the same time these further series confirm the previous results, viz., that serums of high toxin-neutralising potency have not necessarily high germicidal action.

The next point that I proposed to determine with respect of each of the several serums was its protective value; that is to say, its ability to protect an animal against *subsequent* infection with the living microbes. For if serum of this class is to be used for protective purposes in the human subject, its neutralising action on the diphtheria toxin, *i.e.*, its curative property, is not that which is particularly called for. It must be capable of furnishing immunity against subsequent infection with the diphtheria bacilli themselves.

PROTECTIVE INOCULATION IN DIPHTHERIA.

Series I.

In this series a definite dose of a given serum was injected subcutaneously into a guinea-pig, and, 24 hours later, the animal was subcutaneously injected with a dose of living *broth* culture of diphtheria bacillus, such as produced in a control guinea-pig local tumour and death within two days. The animals were of about the same body weight, viz., 230–260 grammes.

No. 1. Of Behring's serum, two guinea-pigs (*a* and *b*) each received 0·05 c.c., and 24 hours later 0·5 c.c. broth culture of diphtheria bacillus 48 hours old.

No. 2. Of Aronson's serum, two guinea-pigs (*c* and *d*) each received 0·05 c.c., and 24 hours later 0·5 c.c. of the same broth culture.

No. 3. Of the "Roux" serum, two guinea-pigs (*e* and *f*) each received 0·05 c.c., and 24 hours later 0·5 c.c. of the same broth culture.

No. 4. Of my own serum, two guinea-pigs (*g* and *h*) each received 0·05 c.c., and 24 hours later 0·5 c.c. of the same broth culture.

A control animal which received 0·5 c.c. of same broth culture was dead, with tumour, in 36 hours.

No. 1. The Behring guinea-pigs showed no tumour; but gradually wasted and died after 11 days.

No. 2. The Aronson guinea-pigs both had tumour, which gradually enlarged and ultimately ulcerated; after 11 days there was extensive ulceration of the skin in the groin, and over the thigh and abdomen. Both animals eventually recovered.

No. 3. The "Roux" guinea-pigs had each slight tumour on second day, which enlarged on subsequent days; the animals became quiet, one did not feed, and both died in 11 days.

No. 4. Of the guinea-pigs treated with my own serum, one had slight swelling on second day, which subsequently enlarged, the animal did not feed well, and was found dead on the fifteenth day. The other guinea-pig was found to develop tumour, which ulcerated during the second week, but the animal ultimately recovered.

Series II.

In this series *gelatine* culture was substituted for the broth culture.

No. 1. Of Behring's serum, two guinea-pigs each received 0·05 c.c., and 24 hours later $\frac{1}{10}$th of a gelatine culture of diphtheria bacillus.

No. 2. Of Aronson's serum, two guinea-pigs each received 0·05 c.c., and 24 hours later $\frac{1}{10}$th of the gelatine culture.

No. 3. Of "Roux" serum, two guinea-pigs received 0·05 c.c., and 24 hours later $\frac{1}{10}$th of the gelatine culture.

No. 4. Of my serum, two guinea-pigs each received 0·05 c.c., and 24 hours later $\frac{1}{10}$th of the gelatine culture. Body weight of the several guinea-pigs about 200 grammes.

A control guinea-pig injected with $\frac{1}{10}$th of same gelatine culture had a big local tumour, and was found dead on the fourth day.

No. 1. The Behring guinea-pigs had each a big swelling on the second day, which increased gradually; one animal died after 10 days, the other had considerable ulceration but eventually recovered.

No. 2. The two Aronson guinea-pigs had each a big swelling on the second day; one died on the fifth day, the other developed ulceration but eventually recovered.

No. 3. Both "Roux" guinea-pigs had slight swelling on second day, were lively, and remained so, although their tumours increased and ulcerated; eventually these animals recovered.

No. 4. One of the guinea-pigs treated with my own serum developed conspicuous swelling, and died after 15 days; the other had only very slight swelling, which disappeared by the end of the week. The animal, however, was found dead after 10 days, although the previous day it appeared quite lively and well.

From these experiments it is clear that none of these serums in the small doses adopted had any but the very slightest protective action against the subsequent injection of a fatal dose of living culture of diphtheria bacillus. Such action as they had showed itself, speaking generally, in retardation of the fatal issue. In none of the animals did the serum prevent the growth and multiplication—*i.e.*, the local tumour—of the bacilli injected, though the injection of the culture of diphtheria bacillus was not delayed more than 24 hours.

Series III.

In the next series 0·1 c.c. of each of the four samples of serum was used per guinea-pig of about 200 grammes weight, and, 24 hours later, a fatal dose ($\frac{1}{10}$) of *gelatine* culture of diphtheria bacillus was injected. The result was interesting, and in harmony with the results previously obtained by simultaneous injection of similar amounts of culture and serum, viz., in none of the guinea-pigs was any tumour developed; the animals remained lively and well.

It appears, then, that in the case of the experimental guinea-pigs, injection of 0·1 c.c. of diphtheria serum 24 hours before inoculation of an otherwise fatal dose of diphtheria bacillus will inhibit the deleterious action of that microbe. Taking the body weight of a young child of six years as 25 kilogrammes, there would be required on the above standard, for protection of such child against infection 24 hours later, as much as 125 c.c. of the serum, while an adult person (70 kilos.) would require 350 c.c. of serum. But it is obvious that actual observation of human beings in a large number of instances is demanded before any conclusion as to the amount of serum required for their protection in the above sense can be arrived at. Dr. Hermann Biggs (of New York) mentioned, at the meeting of the British Medical Association in 1895 in the Public Health Section, that in New York excellent results, in the way of protection of the human subject from diphtheria, were obtained by doses of the serum not larger than are required for curative purposes, *i.e.*, about 10–20 c.c. of anti-toxin per child. On the Continent also, satisfactory results are asserted to have been recorded as obtained with equally small doses. It may be, therefore, that in protective injections of human beings against subsequent natural infection with diphtheria, *e.g.*, children and attendants brought in relation with diphtheria cases, we are dealing with different conditions than when we inject into the subcutaneous tissue of the guinea-pig a fatal

dose of living culture. Infection of a human being under natural conditions, is, perhaps, sometimes a question of infection of the nasal, pharyngeal, or laryngeal mucous membrane with an infinitesimally small dose of diphtheria bacilli; in which case the presence in the system of a comparatively small amount of immunising serum might possibly suffice to render the tissues insusceptible to infection by the diphtheria microbe.

Series IV.

In the next series of experiments attempt was made to ascertain for how many days the protective inoculation of the guinea-pig in the above sense lasts; that is, for what length of time may this passive immunity which is produced by 0·1 c.c. serum per guinea-pig be expected to persist. Roux ("Annals de l'Institut Pasteur," September 1894) found it to last from a few days to a few weeks or even longer. In my experiments 0·1 c.c. of the serum per guinea-pig of 200 grammes in no case protected for more than seven days; moreover, in such case, subsequent injection of an otherwise fatal dose of living gelatine culture of the diphtheria bacillus produced more or less local tumour, though the animal remained alive. A considerable number of experiments were made by me with these different serums, and I found that 0·1 c.c. of one and another of them, per guinea-pig of 200 grammes, is capable of preventing tumour and disease for four days certain. After four days protection was uncertain, and after seven days all animals showed local tumour on injection with an otherwise fatal dose of living gelatine culture; and they were more or less ill, but recovered ultimately.

Series V.

In a last series of experiments attempt was made to ascertain whether, and to what extent, guinea-pigs which after injection of 0·1 c.c. of anti-diphtheria serum had, up to four days, proved completely protected against a fatal dose of living gelatine culture, were capable of responding to a second subsequent injection with living culture of the bacillus diphtheriæ. These experiments were so contrived that guinea-pigs were simultaneously injected subcutaneously each with a mixture of a fatal dose of gelatine culture and with 0·1 c.c. serum; or were injected, first, with 0·1 c.c. of serum, and then, 24 hours to four days later, with an otherwise fatal dose of gelatine culture. The result was in all cases that the animal did not exhibit local tumour and remained quite well. This would seem directly to indicate that the injected bacilli degenerated instead of growing and multiplying.

The same animals were now subjected to an additional subcutaneous injection with an otherwise fatal dose of gelatine culture, with the following result:—If this additional injection with living culture was made seven days after the first, the animals showed tumour next day, were quiet, and did not feed for a day or two. The tumour became, meanwhile, enlarged, and in some cases it sloughed, but the animals eventually recovered. Guinea-pigs submitted to the additional injection with living culture more than a fortnight after the first injection, developed tumour, and nearly 50 per cent. of them died within a few days; and those that did not die showed conspicuous local tumours leading to extensive ulceration. If a month was allowed to elapse between the first and second injection with living culture of diphtheria bacillus, the

difference noticed between the result in the experimental animals and the control animals was slight. All developed local tumour and died, but the control animals died soonest.

It appears, then, that a first injection with living culture which does not produce any noticeable abnormal result owing to the antecedent serum, *i.e.*, no tumour, no illness, no multiplication and growth of the bacilli, fails to confer any high degree of resistance. The observed resistance was considerable up to seven days, and then gradually declined; after a month it was very slight, and was expressed only in delayed death.

No. 3.

FURTHER REPORT on PROTECTIVE INOCULATIONS; by Dr. KLEIN, F.R.S.

I.—THE SOURCE OF THE GERMICIDAL ELEMENT IN BLOOD SERUM.

In previous reports I have shown that guinea-pigs can be protected against a fatal dose of living or of sterilised typhoid bacillus by repeated intraperitoneal injections of non-fatal doses of living culture of this microbe. And so far, my observations are confirmatory of the general principle of immunisation enunciated by Behring, as well as of the particular observations of R. Pfeiffer in respect of immunisation with the cholera vibrio. But I have in addition described experiments by which it is clearly established that, as with the typhoid bacillus so also with the cholera vibrio, with the vibrio of Finkler and Prior, and with bacillus coli, repeated injections of *sterilised* culture per peritoneum produce a condition of the guinea-pig in virtue of which this animal is capable of resisting the intraperitoneal injection of a fatal dose of *living* culture of the microbe of experiment.

In these examples of immunisation by means of *sterilised* cultures, it is of course out of question that immunity was brought about by the action of the living microbes, and therefore indirectly by their toxins. Now Pfeiffer has not admitted that any real lasting immunity is produced by the bacillary bodies alone; he has insisted that for the production of a real specific and lasting immunity the action of the *living* microbe within the infected body is a fundamental condition. Of course under natural conditions, where a previous attack leading to recovery brings about "acquired" immunity against a second attack of the same disease, there has commonly been multiplication within the body of the infecting microbe; but it does not necessarily follow that the immunity in that case results solely from the elaboration by the living microbe in the infected body of its specific toxins. True, in the experiments of Behring, of Behring and Kitasato, of Roux and others a high toxin-neutralising quality of the blood is brought about by previous repeated injections of toxin (as, for instance, in diphtheria and tetanus); but the high toxin-neutralising state of the blood in question is not always associated with a high germicidal potency or immunising action. As a matter of fact, in another report, I show that the two things, antitoxic action and immunising action, in diphtheria at any rate, are separate and not interchangeable results. And in last year's report I showed, by experiments with the cholera vibrio and with the vibrio of Finkler and Prior, that an animal may be rendered thoroughly immune against the living microbe by previous injections of sterilised culture without being thereby rendered immune against the toxin of this microbe.

I do not see how the experiments of mine that are in question can be interpreted otherwise than in the sense I contend for: I showed that certain series of guinea-pigs were, by intraperitoneal injections of non-fatal but gradually increasing doses of sterilised cultures (of the cholera vibrio and of the Finkler and Prior vibrio respectively), brought to such degree of immunity, that a subsequent intraperitoneal injection of fatal doses (tested on control animals) of the living microbes produced no illness; and, consequently, that the tissues and blood of such animals must have acquired germicidal or immunising power whereby the living microbe introduced into the peritoneal cavity became killed and its action neutralised. And, further, I showed that,

notwithstanding that these animals were thus immunised against the living microbe, they nevertheless succumbed when a dose of the potent specific toxin was injected. In these instances, be it observed, the immunising or germicidal substances which must have been present in such animals can have been derived *only* from the dead bodies (intracellular substances) of the microbes injected during immunisation as sterilised culture.

These conclusions I have put to some further tests with regard to the typhoid bacillus, to the diphtheria bacillus, and to the cholera vibrio, as follows:—

A.—*Typhoid Serum.*

First Series.

Typhoid serum derived from a horse, highly immunised by injection of *living* culture of typhoid bacilli, was obtained through Dr. Horton Smith from the Institute of Preventive Medicine. It was tested in the following manner:—

(*a*.) *Bordet-Durham Test.*—Cultivations were made on the slanting surface of agar of the following samples of typhoid bacillus: (1) laboratory typhoid bacillus, originally derived from the spleen of a fatal case of typhoid fever; (2) laboratory colon bacillus (typical) derived from human fæcal matter; (3) typhoid bacillus derived from the interior of an oyster that had been kept in "typhoid infected" sea water; (4) typhoid bacillus derived from sea-water 16 days after it had been infected with culture of typhoid bacillus; (5) typhoid bacillus isolated by Dr. Horton Smith from the urine of a case of typhoid fever during the fourth week; [this bacillus, obtained from the urine in numerous colonies, was in all respects—morphologically, as regards flagella, and in cultural characters—identical with the typical typhoid bacillus]; (6) typhoid bacillus isolated by Dr. Horton Smith from the urine of the same case, but at a later date; (7) typhoid bacillus isolated from the urine of a case of relapse of typhoid fever. [In this case the temperature (in the sixth week after the first onset of the primary fever) had again fallen to normal; nevertheless, the urine contained at this stage the typhoid bacillus typical in every respect and in pure culture.]

These agar cultures having been incubated at 37° C. for 48 hours, a bouillon emulsion was in each instance made of the growth, and to each such distribution about 1 per cent. of the typhoid serum from this horse was added. As a result, in regard of every sample of typhoid bacillus, aggregation into clumps with quick settlement of the bacilli in a rapidly clearing fluid was most marked; but the distribution of bacillus coli scrapings remained altogether unaffected.

The Bordet-Durham test yielded, therefore, with all the above samples, except the colon bacillus, characteristic and positive results.

(*b*.) *Pfeiffer's Test.*—This typhoid serum was next subjected to Pfeiffer's test with reference to each of the several microbes, the same cultures as before being used. In each case a "control" guinea-pig received $\frac{1}{8}$th of the culture into its peritoneal cavity, while another guinea-pig received per peritoneum $\frac{1}{8}$th of the culture *plus* 0·5 cubic centimetre of the typhoid serum. The result was very curious:

(1.) With sample (1), laboratory typhoid bacillus, the control animal was found dead in 20 hours; the "serum *plus* typhoid bacillus" animal remained lively and well.

(2.) With sample (2), laboratory bacillus coli, the control animal was dead in 20 hours; the "serum *plus* colon bacillus" guinea-pig remained lively and well.

(3.) With sample (3), typhoid bacillus from infected oyster, the control animal was dead in 20 hours: the "serum *plus* typhoid bacillus" animal remained lively and well.

(4.) With sample (4), typhoid bacillus from infected sea water, the control guinea-pig and the "serum *plus* typhoid bacillus" guinea-pig remained alike lively and well.

(5.) With sample (5), typhoid bacillus from urine of a person ill of enteric fever, the control animal was found dead in 20 hours. The "serum *plus* typhoid bacillus" guinea-pig was at this date alive, but quiet and not feeding; on the third day, however, it was much better, and was quite normal on the fourth day.

(6.) With sample (6), typhoid bacillus of urine of same case of fever but a little later, the control animal was dead in 20 hours. The "serum *plus* typhoid bacillus" guinea-pig was at this date alive, but quiet and not feeding; on the third day, however, it had recovered.

(7.) With sample (7), typhoid bacillus from urine during relapse of typhoid fever, the control guinea-pig was next day lively and well. The "serum *plus* typhoid bacillus" animal was distinctly ill at this date; on the third day it was very ill, and died in the evening.

While, then, this typhoid serum from the horse gave striking and uniform result with the Bordet-Durham test, it failed to give an equally uniform result with Pfeiffer's test. As regards the latter test, not only did it fail to protect the experimental guinea-pig against sample No. 7 of typhoid bacillus, but at the same time it *did* protect against bacillus coli. Sample (4), *i.e.*, typhoid bacillus from infected sea water, may be left out altogether, since both the control animal and the test animal remained unaffected.

Second Series.

In this series, serum was obtained from a guinea-pig which had been immunised with *living* typhoid culture in the following manner:

Jan. 21st it received	intraperitoneally		$\frac{1}{8}$th	of a living agar culture of the typhoid bacillus, 48 hours old.
Jan. 30th	"	"	$\frac{1}{6}$th	
Feb. 29th	"	"	$\frac{1}{5}$th	
Mar. 9th	"	"	$\frac{1}{4}$th	
Mar. 21st	"	"	$\frac{1}{4}$th	

On the first occasion of injection, this particular guinea-pig reacted well; the animal was indeed so much affected that it was expected to die. It gradually recovered, however, and was well again after lapse of six days. On the second occasion of injection it reacted slightly, as also on the third occasion. In both instances it was quiet and not feeding in the evening; but was better next day, and had quite recovered on the third day. On the fourth occasion (March 9th) it reacted well; was still ill next day—a companion animal died—but had recovered on the third day. On the occasion of its fifth injection this animal did not react; it was found quite normal the next day.

This guinea-pig was then killed on April 13th (*i.e.*, 23 days after the last injection), its blood collected, and with the serum therefrom the following experiments were made with the same six samples of typhoid bacillus and the one sample of bacillus coli which were dealt with in the first series.

(*a.*) *Bordet-Durham Test.*—All samples of microbe cultures, except the distribution of bacillus coli, reacted well to this guinea-pig serum. The aggregation of the bacilli into clumps and the settling down of these

was pronounced with every one except bacillus coli. The latter was quite unaffected by addition of the serum.

(*b*.) *Pfeiffer's Test*.—This was made in the same manner as in the first series, except that instead of injecting into the peritoneum $\frac{1}{8}$th of a culture, I injected $\frac{1}{4}$th in order to ensure fatal result in the control animals. The result was this:

(1.) With sample (1), laboratory typhoid bacillus, control animal dead in 20 hours; "serum *plus* typhoid bacillus" guinea-pig very ill next day, found dead on third day.

(2.) With sample (2), laboratory colon bacillus, control animal dead in 20 hours; the "serum *plus* colon bacillus" guinea-pig lively and well next day.

(3.) With sample (3), oyster typhoid bacillus, control animal dead in 20 hours; the "serum *plus* typhoid bacillus" animal lively and well next day.

(4.) With sample (4), typhoid bacillus from infected sea water, control animal dead in 20 hours; the "serum *plus* typhoid bacillus" animal lively and well next day.

(5.) With sample (5), typhoid bacillus from urine of a person ill of enteric fever, control animal not affected; "serum *plus* typhoid bacillus" animal ill next day, found dead on the third day.

(6.) With sample (6), typhoid bacillus from urine at later stage of fever than (5), control guinea-pig dead in 20 hours; "serum *plus* typhoid bacillus" animal ill next day, found dead on the third day.

(7.) With sample (7), typhoid bacillus from urine in relapse of enteric fever, both animals ill in the evening, dead in 20 hours.

This series is an interesting confirmation of the first. Here again the serum responded to the Bordet-Durham test with samples of the typhoid bacillus, but not with bacillus coli, whereas with Pfeiffer's test it failed to distinguish between these bacilli. With the latter test, too, while exhibiting very slight inhibitory action on the laboratory typhoid bacillus, through which it had itself been derived, it exercised germicidal action on the oyster typhoid bacillus and on the sea-water typhoid bacillus, both of which were descended from the laboratory typhoid bacillus; and finally, it had no appreciable germicidal effect on the typhoid bacilli from urine. It follows, then, from these two series of experiments, that Pfeiffer's test did not in these instances help towards diagnosis.

Third Series.

In this series the serum was used of a guinea-pig which had been immunised by intraperitoneal injection of *sterilised* culture of the typhoid bacillus, in the following manner:—

March 2nd.—Three guinea-pigs (Nos. 1, 2, and 3) were each intraperitoneally injected with $\frac{1}{4}$th of an agar culture of the typhoid bacillus which, along with the bouillon wherein it was distributed, had been previously sterilised for 10 minutes at 70° C. In the evening of same day the animals were quiet and not feeding. Next morning they were still quiet and did not feed; but on the third day they were again lively and fed well.

March 9th.—Each of the three guinea-pigs received, as before, intraperitoneally, $\frac{1}{4}$th of a sterilised agar culture of typhoid bacillus. All the animals were slightly affected the same evening, but seemed quite normal next day.

March 21st.—Each of the three guinea-pigs received intraperitoneally $\frac{1}{4}$th of a sterilised agar culture of typhoid bacillus. All the animals were affected the same evening, but had quite recovered next day.

April 13th.—Each of the three guinea-pigs received intraperitoneally $\frac{1}{4}$th of a sterilised agar culture of typhoid bacillus. All the animals were quiet and not feeding in the evening, but had recovered next day.

May 6th.—Each of the three guinea-pigs received intraperitoneally $\frac{1}{4}$th of a sterilised agar culture of typhoid bacillus. No effect.

May 11th.—Each animal received $\frac{1}{4}$th of a sterilised agar culture of typhoid bacillus. One was very ill in the evening of the day of experiment, the other two were only slightly affected. On the third day they seemed all right again; were lively and fed well.

May 20th.—All three animals were injected again each with $\frac{1}{4}$th of a sterilised agar culture of typhoid bacillus. Two were slightly quiet in the evening; but next day all appeared normal.

One was then (May 30th) killed, and with its serum, experiments were made on the "laboratory typhoid bacillus," and on the "oyster typhoid bacillus." In each instance $\frac{1}{4}$th of an agar culture and 0·5 cubic centimetre of the serum were administered to several animals. A control guinea-pig received at the same time, in each instance $\frac{1}{8}$th of an agar culture of the bacillus of experiment. The result was that the control animals were found dead next morning, whereas the "serum *plus* typhoid bacillus" guinea-pigs were alive and well. So that it was proved that the serum of a guinea-pig immunised by repeated intraperitoneal injection of large doses of *sterilised* typhoid culture possessed the same germicidal and immunising action as serum obtained by immunisation with *living* culture.

I have repeated these experiments in obtaining germicidal serum in two further and parallel series; the serum of the one series having been obtained by immunisation of guinea-pigs with *living* culture, that of the other series by immunisation with *sterilised* culture of the typhoid bacillus. The result was briefly this. After six injections with *living* culture ($\frac{1}{8}$, $\frac{1}{8}$, $\frac{1}{5}$, $\frac{1}{4}$, $\frac{1}{4}$, and $\frac{1}{4}$ of a culture respectively) good germicidal serum was obtained; after eight injections with *sterilised* culture ($\frac{1}{5}$, $\frac{1}{4}$, $\frac{1}{4}$, $\frac{1}{4}$, $\frac{1}{3}$, $\frac{1}{3}$, $\frac{1}{3}$, and $\frac{1}{3}$ of a culture respectively) serum was obtained of equal germicidal power.

B.—*Diphtheria Serum.*

In the Medical Officer's report for 1893–94, I showed, p. 473, that diphtheria bacilli do not, unlike the other microbes dealt with in my previous report of 1892–93,* contain within their bodies (intracellular substances) poisonous principles, which, when injected in sufficient quantity into the peritoneal cavity of a guinea-pig, produce acute intensive peritonitis and death. I demonstrated indeed, not only in regard of the diphtheria bacillus, but also of sporeless anthrax bacillus, and of the bacillus of fowl cholera, that large quantities of *sterilised* culture of these microbes can be injected into the peritoneal cavity of this animal without producing symptoms of poisoning.

Now the guinea-pig is an animal highly susceptible to *subcutaneous* injection of *living* diphtheria culture, so much so that $\frac{1}{8}$th or $\frac{1}{6}$th of a recent gelatine surface culture of the typical diphtheria bacillus kills with certainty one kilogramme guinea-pig in 30–36 hours, with the

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* Vibrio of cholera, vibrio of Finkler, bacillus coli, typhoid bacillus, bacillus prodigiosus, and proteus vulgaris.

usual local and general symptoms. Wherefore a fact ascertained during this year's work is the more remarkable. This fact is that a like (fatal) dose injected into the *peritoneal cavity* of a guinea-pig of equal weight may leave the animal unharmed; beyond a disposition to quietness* in the evening of the injection, no serious symptom is exhibited, and the animal remains alive. Examination of the peritoneal fluid of several guinea-pigs, which had been thus intraperitoneally injected, was made, and it was found that living diphtheria bacilli can be obtained therefrom only in the earlier stages of the experiment, and to a very limited degree; later than six hours after injection no living cultures can be obtained from their peritoneal fluid. The peritoneal cavity, therefore, of a normal guinea-pig is totally unlike the subcutaneous tissue of this animal, in that it is not a suitable nidus for the growth and activity of the diphtheria bacillus; in fact, the normal peritoneum of the guinea-pig acts to a certain extent germicidally on the diphtheria bacillus. This is altogether exceptional; the peritoneal cavity being, as is well known, for many microbes, a more suitable locality for starting the infective process—infection therein being achieved very easily—than the subcutaneous tissue. It is indeed experimentally established that in the case of the cholera vibrio, the typhoid bacillus, the swine fever bacillus, bacillus anthracis, and many other living infective agents, growth and multiplication within the animal body of the microbe, followed by fatal result, is achieved more easily, and with smaller doses, by the way of the peritoneal cavity than by means of subcutaneous injection. Even in the case of so called non-pathogenic microbes, *e.g.*, the bacillus prodigiosus and bacillus coli, growth and multiplication of these microbes with fatal result is achieved by intraperitoneal injection with far smaller doses than by subcutaneous injection.

The experiments that prove that, intraperitoneally administered, an otherwise fatal dose of a *living* gelatine culture of the diphtheria bacillus leaves the guinea-pig unharmed are the following:—

Experiment 1.—Two guinea-pigs, Nos. 1 and 2, received each $\frac{1}{4}$th of a living gelatine culture of diphtheria bacillus *intraperitoneally;* a third (control) guinea-pig, No. 3, of same weight (about 260 grammes), received at the same time, but *subcutaneously*, $\frac{1}{8}$th of the same culture.

[The culture in this, and in all other cases to be presently referred to, was made on the slanting surface of gelatine (6 centimetres long and 2 broad) in three streaks. The test tube thus inoculated was then incubated for 10 to 14 days at 20 to 21° C., by which time each streak was marked as a broad, thick, white, knobbed band. A definite quantity of sterile broth was now added to the culture tube, the growth rubbed from the gelatine surface, and the mixture poured off. Of this distribution of bacillus growth in broth, $\frac{1}{4}$th, $\frac{1}{8}$th, or $\frac{1}{10}$th of a culture per animal was used for injection.]

The above three guinea-pigs were found a little quiet in the evening (probably as a result of the chloroform narcosis). Next day the control guinea-pig was distinctly ill, and had a tumour at the seat of injection; the two intraperitoneally injected animals were, however, lively and well. The control guinea-pig was found dead, with big local tumour, in 36 hours; the other two guinea-pigs remained lively and perfectly well.

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* It must be mentioned that all animals injected intraperitoneally are put fully under an anæsthetic, in order to prevent movement during penetration of the needle of the syringe into the peritoneal cavity, so as to avoid injury to the intestine. The quietness in the evening, therefore, of experimental animals may have been due to the previous anæsthesia.

Experiment 2.—Four guinea-pigs (Nos. 4, 5, 6, and 7) received each, *intraperitoneally*, ⅛th of a living gelatine culture of diphtheria bacillus, and a control guinea-pig, No. 8, received ⅛th of same culture *subcutaneously*. The control animal was found next morning quiet, and exhibiting subcutaneous tumour; it was dead in 40 hours. Nos. 4, 5, 6, and 7 were slightly quiet in the afternoon of the day of injection; next morning they were livelier, but did not feed well. Two of them, Nos. 4 and 5, died on the fifth day; and, on post-mortem examination, their peritoneal cavities contained copious sanguineous exudation, while the abdominal viscera were much congested. Cultivations made of the peritoneal fluids produced a pure crop of bacillus coli; no diphtheria bacilli.

In this case, then, the injection caused a passage of bacillus coli into the peritoneal cavity with multiplication of this microbe there, and death as a result of its life processes. Similar cases of accidental colon-infection have been mentioned by other observers as occurring occasionally after intraperitoneal injection of microbes other than bacillus coli. Gärtner, for instance, has seen a similar result after coccus injection; and I myself have described in a former report the occurrence of colon-infection after bacillus prodigiosus injection. I have explained such accidental infection by assuming that during injection an accidental slight injury to the intestine (without actual perforation) has caused the passage of bacillus coli from the interior of the intestines into the peritoneal cavity, wherein it multiplied and caused intensive peritonitis and death; indeed, bacillus coli obtained from the peritoneal fluid in such instances is characterised by great virulence. The above two guinea-pigs, Nos. 4 and 5, then, must be eliminated from consideration in this experiment.

Guinea-pig No. 6 was quiet and did not feed; it was found dead on the ninth day. On post-mortem examination slight peritonitis, with thickening of, and minute abscesses in, the omentum next the stomach were found. No diphtheria bacilli were recovered by cultivation. Guinea-pig No. 7 was lively and well on the third day and remained so.

We see, then, that out of four guinea-pigs injected intraperitoneally with an otherwise fatal dose of living virulent diphtheria bacilli, one succumbed on the ninth day, two on the fifth day, while one remained alive. All that eventually died under the circumstances noted had appeared only slightly quiet soon after the injection (see previous footnote as to anæsthesia), whereas control guinea-pigs injected subcutaneously with a like dose succumbed within 48 hours.*

It must be, however, remembered that although a guinea-pig will resist intraperitoneally a dose of gelatine culture, which subcutaneously administered to a control guinea-pig of the same weight would cause death with certainty within 48 hours, it is not able to resist an excessive dose administered per peritoneum. This is notably the case when recent agar cultures are used instead of gelatine cultures, as will presently be shown. But, as I have said, the point upon which I would now insist is that the peritoneum of a guinea-pig is considerably less susceptible than its subcutaneous tissue; provided the dose injected intraperitoneally be not excessive—though large enough to cause death when subcutaneously injected—the animal remains well and the bacilli are killed within the peritoneum very quickly. This being the case, it follows that whatever

* A large number of guinea-pig have been injected subcutaneously with like doses of the same stock of gelatine cultures of diphtheria baccillus as control animals in other series of experiments with diphtheria antitoxin. Without exception these control guinea-pigs succumbed in less than 48 hours, as a rule in 30–36 hours.

the change in the tissues and blood effected in such animals by the injection, such change cannot be due to growth and multiplication of the bacilli and the production by them of toxins, ***but must be due to substances derived from the bodies of the bacilli themselves, that is, from their protoplasm.***

That the result of intraperitoneal injection of living agar culture is less satisfactory in this connexion than injection of gelatine culture, is shown by the following experiments:—

Experiment 3.—Five guinea-pigs each received, intraperitoneally, $\frac{1}{4}$th of a living agar culture of bacillus diphtheriæ (grown three days at 37° C.), while a control guinea-pig received subcutaneously $\frac{1}{4}$th of same culture.

The control animal and three of the others were found dead after 30 hours; of the two remaining, one was found dead on the fourth, the other on the fifth day. Cultivations were made of the peritoneal exudation—which was present in every one of the animals—but only in one case were a few diphtheria colonies obtained; the exudation of four of these intraperitoneally injected animals did not produce any colonies.

But in all five cases the omentum next to the stomach was much congested, containing within and without patches of lymph. These on microscopic examination were found full of diphtheria bacilli, in leucocytes and free; and cultivations made with the lymph yielded in all cases abundance of diphtheria colonies.

Experiment 4.—Four guinea-pigs, each weighing 230–250 grammes, each received intraperitoneally $\frac{1}{10}$th of a living agar culture of diphtheria bacillus 48 hours old, and two control guinea-pigs of equal weight (*i.e.*, 230–250 grammes), each received subcutaneously an equal amount of the same culture. The two control animals were found dead in 36 hours with characteristic tumours. One of the intraperitoneally injected guinea-pigs was found dead on the fourth day. The other three were slightly off their feed, though otherwise lively, for a day or two after injection; but by the third or fourth day had seemingly quite recovered.

It is, therefore, clear that an agar culture in a dose which acts fatally in 36 hours when subcutaneously injected, does not, in the majority of instances, when administered intraperitoneally, produce marked disease, and does not necessarily lead to death. In Experiment 3 the dose administered intraperitoneally ($\frac{1}{4}$th of a culture) was evidently too large, and in that case the result was practically the same in the experimental guinea-pigs as in the control animal injected subcutaneously.

The difference in the results obtained by agar culture and by gelatine culture seems to me to be due to the presence in the former cultures of appreciable amounts of toxin, washed off along with the growth in the process of rubbing the latter down with the salt solution or the bouillon. Agar cultures with slanting surface, even if they appear free of condensation fluid at ordinary temperature, exhibit as a rule a small amount of it when incubated for a day or two at 37° C. Consequently when a diphtheria culture on the slanting surface of agar has been incubated at 37° C. for a day or two, there is always in the test tube a few drops of condensation fluid which, owing to growth of the bacillus in it, has become quite turbid. Such a culture scraped down and distributed in salt solution or in bouillon, always contains, therefore, an appreciable amount of toxin (produced by the diphtheria bacilli in the condensation fluid), and the injection of this toxin into the peritoneal cavity in addition to the bacilli must necessarily influence the nature of the result; for 0·25 cubic centimetre of toxin, produced in broth culture in 48 hours at 37° C., suffices to kill within 48 hours a guinea-pig weighing $\frac{1}{2}$ kilo. Gelatine

cultures are free from condensation fluid, and therefore by using the growth from a gelatine culture, addition in the above way of toxin is avoided.

However this may be, it is well enough established that intraperitoneal injection of a dose of diphtheria bacilli from gelatine culture which would just prove fatal if administered subcutaneously, does not produce any recognisable disease in the guinea-pig. Again and again I have prepared guinea-pigs by intraperitoneal injection of an otherwise (subcutaneous) fatal dose of diphtheria bacilli taken from gelatine cultures, with no result to these animals except that they were slightly quiet in the evening of the day of injection. Next day they were always found lively and well.

Another set of guinea-pigs was prepared in different manner, thus:

While working with diphtheria antitoxin* I inoculated *subcutaneously* a considerable number of guinea-pigs with an ordinarily fatal dose of gelatine culture of diphtheria bacillus, adding thereto before injection a certain amount of antitoxic serum (derived from the horse immunised by injection with living culture, or obtained by the Behring, the Aronson, or the Roux methods), with the result that not one of these guinea-pigs showed local tumour or any sort of illness. In these cases, then, the addition of the antitoxic serum to the living culture had prevented the diphtheria bacilli from growing and multiplying in the subcutaneous tissue and from producing their toxin there. Hence no local tumour appeared, and the animals remained well. Further, I so dealt with other guinea-pigs that they received subcutaneously a definite amount of antitoxic serum, and, 24 hours later, a dose, also *subcutaneously*, of living gelatine culture of diphtheria bacillus which, in a control guinea-pig, sufficed to produce local tumour and death in 36 hours. The result was again nil; no tumour appeared, and the animals remained alive and well.

We may take it, then, that it is possible by one means or another to prevent the diphtheria bacilli that are injected into an experimental animal from growing and multiplying, and from producing their toxin. Consequently, if in such animals any alteration in the tissues and blood is brought about, it cannot be due to toxin produced by the injected bacilli; for these do not grow and multiply, on the contrary, they are killed off.

Animals that had been thus dealt with were next subjected to repeated *intraperitoneal* injection with increasing doses of living diphtheria bacilli. The result was, as a rule, slight quietness of the animals in the evening after injection, probably due to the chloroform narcosis; generally they were found lively and well next morning. Occasionally only an animal which seemed to have stood very well three or four previous injections, suddenly developed on a further injection alarming symptoms, and either succumbed or took some days to recover.

In the following experiments I propose dealing only with such guinea-pigs, 12 in number, as went through a series of these subsequent intraperitoneal injections, and remained lively and well after each such injection. For it is only in regard of such animals that it can be said that the injected diphtheria bacilli did not grow and multiply, and did not produce toxin within the animal.

To show the character of these experiments I mention the following :—

1. Guinea-pigs that had been prepared in one or other of the above ways, and which had not shown any disease after the injection (whether

* See Report on "Prophylaxis in Diphtheria" in this volume.

intraperitoneal or subcutaneous, or whether simultaneous with or subsequent to the antitoxin injection) of living diphtheria bacillus, were subjected to *intraperitoneal* injection with ⅛th of a living gelatine culture of the microbe. A control guinea-pig of the same weight which was *subcutaneously* injected with an equal amount of the same culture died in 30 hours. The experimental animals were merely a little less lively in the evening, but next morning they were quite normal again.

2. Each of the above animals received 15 days later, *intraperitoneally*, ⅛th of a living gelatine culture of diphtheria bacillus. No result.

3. Each of the above animals received, *intraperitoneally*, ⅕th of a living gelatine culture of the diphtheria bacillus after further 22 days. No result.

4. Each of the above animals received, *intraperitoneally*, ¼th of a living gelatine culture of diphtheria bacillus after further seven days. No result.

5. Each of the above animals received, *intraperitoneally*, ¼th of a living gelatine culture of diphtheria bacillus after further eight days. No result.

Four guinea-pigs of this group were now, 15 days after the last injection, tested *subcutaneously* with ⅛th of a living gelatine culture of diphtheria bacillus. A control animal of about the same weight, which received a like dose, was dead in 30 hours with big tumour at the seat of injection. Of the above experimental animals one had two days later a slight swelling at the seat of injection but was otherwise lively and well; the remaining three had no trace of swelling, were lively and well, and all four of them remained well and normal subsequently.

It is clear from this that three of these four guinea-pigs had been immunised by the antecedent intraperitoneal injections; and that the fourth animal though protected was but incompletely so, since it developed slight tumour.

6. The remaining guinea-pigs (that is, those not used for this test experiment), eight in number, each received *intraperitoneally* ⅓rd of a living gelatine culture of diphtheria bacillus, 18 days after the last (fifth) injection. They were quiet on the evening of the injection and two of them were off their feed. Next day these two were still quiet and off their feed, and one of them was found dead in the evening of the second day. The dose injected was, then, too large for these two animals.

7. The six guinea-pigs that had not been affected in the previous experiment received, each *intraperitoneally*, ⅓rd of a living gelatine culture of diphtheria bacillus after further ten days. No result.

These six animals were now considered to be sufficiently protected; and their protection—as indeed was evidently already the case after the fifth injection—could not have been caused by growth and multiplication of the diphtheria bacilli in their bodies, with production by the microbe of toxin, since, as we have seen, no illness was produced in any of them. The protection afforded these guinea-pigs must have been caused by the substances of the bacilli themselves; in other words, the condition of insusceptibility exhibited by the otherwise extremely susceptible subcutaneous tissue of the other four guinea-pigs in the test experiment above mentioned must needs have been brought about by the bacillary substances themselves.

That these six remaining guinea-pigs had now acquired a high degree of general insusceptibility was proved, at any rate on some of them, by

subjecting them, after the above seven intraperitoneal injections, to *subcutaneous* injection with large doses of living diphtheria culture in this way :—

8. Into one of them $\frac{1}{4}$th of a living gelatine culture was injected subcutaneously three weeks after the last (7th) intraperitoneal injection. A control guinea-pig of about the same weight, which received half of this dose subcutaneously, was dead in 36 hours with large tumour. The prepared guinea-pig had no tumour; it was lively and well and remained so.

9. Into each of certain others of the above guinea-pigs $\frac{1}{2}$ cubic centimetre of a living broth culture of diphtheria bacillus that had been incubated for 48 hours at 37° C. was injected subcutaneously. A control animal which received the same amount of the broth culture was found dead in 24 hours. The prepared animals had no tumour; they were lively and well and remained so.

I think it hereby proved that the above guinea-pigs had been well protected by the previous intraperitoneal injections with living gelatine culture.

To show that the blood of these animals possessed high germicidal action on the diphtheria bacillus I selected three of those remaining, which had the following history :—

Guinea-pig a, injected—

1. Intraperitoneally with $\frac{1}{5}$th
2. " " $\frac{1}{5}$th
3. " " $\frac{1}{5}$th
4. " " $\frac{1}{4}$th
5. " " $\frac{1}{4}$th
6. " " $\frac{1}{3}$rd
7. " " $\frac{1}{3}$rd

of a living gelatine culture of diphtheria bacillus. No physiological effect.

Guinea-pig b, injected—

1. Subcutaneously with a mixture of $\frac{1}{5}$th of a living gelatine culture of diphtheria bacillus and 0·05 of a cubic centimetre of Behring's 600 unit diphtheria antitoxin. The animal showed no tumour and remained lively and well.
2. Intraperitoneally with $\frac{1}{5}$th
3. " " $\frac{1}{5}$th
4. " " $\frac{1}{4}$th
5. " " $\frac{1}{4}$th
6. " " $\frac{1}{3}$rd
7. " " $\frac{1}{3}$rd

of a living gelatine culture of diphtheria bacillus. No physiological effect.

Guinea-pig c, injected—

1. Subcutaneously with dried antitoxin, and, 24 hours later, subcutaneously with $\frac{1}{5}$th of a living gelatine culture of diphtheria bacillus. No tumour, the animal remained lively and well.
2. Intraperitoneally with $\frac{1}{5}$th
3. " " $\frac{1}{5}$th
4. " " $\frac{1}{4}$th
5. " " $\frac{1}{4}$th
6. " " $\frac{1}{3}$rd
7. " " $\frac{1}{3}$rd

of a living gelatine culture of diphtheria bacillus. No physiological effect.

These animals were killed, their blood collected, and the serum separated. With this serum experiments were so contrived that in each series one guinea-pig served for control, and received subcutaneously $\frac{1}{4}$th of a living gelatine culture of diphtheria bacillus, while two other

guinea-pigs each received subcutaneously a mixture of the same dose of the gelatine culture and 0·5 of a cubic centimetre of the serum. The results were uniform and striking, viz.:—The control animal was in all three series of experiments found dead within 30 hours, whereas the other two guinea-pigs in each series remained without tumour, were lively, and remained well.

This serum, that acted so well *in corpore*, was next subjected to the Bordet-Durham test *in vitro*, but no positive result was obtained.

C.—*Cholera Serum.*

In this series of experiments my object was to obtain and test the serum of guinea-pigs which had gone through the process of immunisation, some by intraperitoneal injections of *living*, some by intraperitoneal injection of *sterilised*, culture of the cholera vibrio. In all instances the cultures were agar surface cultures incubated at 37° C. for 48 hours. The sterilisation was carried out by heating the bouillon distribution of a culture for ten minutes at 70° C.

The amounts used for intraperitoneal injection, at intervals of 14 days, were:—of the cholera vibrio, $\frac{1}{5}$th of a living culture at starting, $\frac{1}{5}$th the second time, $\frac{1}{5}$th the third time, $\frac{1}{4}$th the fourth and fifth times, $\frac{1}{3}$rd the sixth time. In the case of sterilised culture, injection was made from week to week, $\frac{1}{5}$th, $\frac{1}{5}$th, $\frac{1}{4}$th, $\frac{1}{4}$th, $\frac{1}{4}$th, $\frac{1}{3}$rd, $\frac{1}{3}$rd, $\frac{1}{3}$rd of a culture being used.

Of each series one animal was then used for obtaining blood-serum, and it was found that serum from both animals had germicidal action. Thus, while control guinea-pigs that each received intraperitoneally $\frac{1}{5}$th of a recent living cholera culture were found dead next morning, those into which a mixture of $\frac{1}{5}$th of the same culture and 0·25 cubic centimetre of serum obtained by the one or the other method was injected remained alive. With both kinds of serum the Bordet-Durham test *in vitro* was carried out; and it was found that $\frac{1}{10}$th of a cubic centimetre of either serum added to one cubic centimetre of distribution of cholera vibrios gave indication of positive result in 15 minutes. In 30 minutes the upper portion of the fluid in each instance was quite limpid, and the aggregated vibrios had settled down at the bottom of the test tube.

It follows, then, from these experiments that germicidal cholera serum can be obtained equally with living and with sterilised culture; and that therefore, in the case of the cholera vibrio, as in the case of the typhoid bacillus, the immunising or germicidal substances are derived from the bodies of the microbes themselves, and are distinct from the antitoxin produced by the specific toxins.

This proposition I have maintained for several years now, having shown (1892) that immunisation of guinea-pigs can be effected equally with living and with sterilised cultures. It is gratifying therefore to me to find that R. Pfeiffer has come recently to the same conclusion. He states (Zeitschrift f. Hygiene and Inf., vol. xx., p. 199) that germicidal serum (*i.e.*, perfect immunisation) can be obtained equally with living and with dead cultures.* In my report for 1893 I demonstrated that though guinea-pigs, by preparatory intraperitoneal injection of sterilised culture, are immunised against an ordinarily fatal dose of living culture, they are *not* thereby immunised against the specific toxin. Hence I have insisted on definite distinction between immunisation

* Dr. Pfeiffer has kindly sent me some of his cholera serum. I have tested and compared it with my own, both as regards Bordet-Durham test and Pfeiffer's test; and I have found that the efficiency is the same.

produced by living and by sterilised culture. In the former case the immunisation results, in my view, from the toxins produced by the living and multiplying microbes in the infected animal *plus* the substances contained in bacillary bodies of the microbes themselves; in the latter (immunisation by sterilised culture) the refractory condition produced in the animal can be due solely to the bacillary body substances themselves. To express it differently in the light of the researches that have been carried out in connexion with diphtheria antitoxin, it may be stated that in the case of immunisation by living culture the acquired refractory condition of the animal is due both to antitoxin and to germicidal substances, whereas in immunisation produced by sterile culture the refractory condition is due *solely* to germicidal substances.

II.—Additional Experiments with "Typhoid Serum" from the Calf.

In my last year's report on the Etiology of Enteric Fever, I have described experiments indicating that the blood serum of guinea-pigs intraperitoneally immunised against the typhoid bacillus possesses germicidal properties against living typhoid bacillus if that microbe be introduced along with it into the animal body. Thus, I showed that if a certain amount of this serum be added to an otherwise fatal dose of typhoid bacilli, and the mixture is injected intraperitoneally into an unprepared guinea-pig, the latter will survive. Further I showed, as has Pfeiffer in the case of the cholera vibrio, that the introduction of a dose of typhoid bacilli into the peritoneal cavity of an immunised guinea-pig is followed by a rapid degeneration and disappearance of the bacilli within the peritoneum of the experimental animal; whereas in a control guinea-pig the bacilli live, multiply, and cause disease.

My experiments comprised a number made on calves, as to which I sought, by repeated subcutaneous injection of large amounts of typhoid bacillus culture, to furnish their blood serum with germicidal action against the typhoid bacillus; and included also several series of guinea-pigs, upon which a germicidal action of this calf serum was demonstrated, germicidal action limited in degree and of lesser power than might, perhaps, have been anticipated.

During 1895–96 I have made additional experiments for the purpose of increasing the germicidal action of the blood serum of calves thus immunised against the typhoid bacillus.

(*a*.) The two calves, No. 1 and No. 2, referred to in my last year's report,* were injected for the tenth time on May 10th, 1895, each receiving 12 cubic centimetres of living broth culture of the typhoid bacillus that had been growing at 37° C. for seven days. On the following day each animal had a big soft swelling at the seat of inoculation, but they both fed well, and their temperature was not raised. The tumours on the following day had diminished, and were almost completely gone by the end of the fifth day. Calf No. 2 was bled tentatively on June 10th, *i.e.*, a month later, and with its blood serum the following experiments were made:—

1. A control guinea-pig received *intraperitoneally* a dose of living agar culture (one-quarter of a culture) of the typhoid bacillus.

* Report of the Medical Officer to the Local Government Board for 1894–95 pp. 403–406.

2 and 3. Two guinea-pigs each received, ***intraperitoneally***, a like amount of this culture, and, ten minutes later, one-half a cubic centimetre of the above calf's serum, also ***intraperitoneally***. All three guinea-pigs were of about the same weight, viz., 556–610 grammes.

In the evening of the day of injection the control animal was quiet and ill; the others (Nos. 2 and 3) were seemingly not affected. Next morning the control animal was found moribund, and it died in the course of the day (about 24 hours after injection), whereas the other two guinea-pigs were lively and well, and they remained so.

There can then be no doubt that in this case one-half of a cubic centimetre of the calf's serum had decided germicidal effect on the typhoid bacillus.

The calf serum was also tested at this stage in regard of its possible general *protective* action:—

Four guinea-pigs each received ***subcutaneously*** one cubic centimetre of the serum. Of these Nos. 1 and 2 received ***intraperitoneally*** two hours later, Nos. 3 and 4 *intraperitoneally* 24 hours later, an ordinarily fatal dose of typhoid bacillus culture. A fifth guinea-pig served as control, receiving *intraperitoneally* the same dose ($\frac{1}{8}$th) of typhoid bacillus culture.

The result was that all five animals were ill in the evening of their injection with typhoid bacillus culture, and were found dead next morning.

(*b*.) Both calves were injected again on June 13th, each animal receiving 14 cubic centimetres of a seven days' old broth culture of the typhoid bacillus. Next day both had big soft swelling at the seat of inoculation. They fed well, however, and their temperature was not raised. About the end of the week there was a hard tumour present in each calf at the site of inoculation, but the animals appeared otherwise in normal condition.

(*c*.) The calves were injected again on June 25th, each animal receiving 15 cubic centimetres of a six days' old broth culture of the typhoid bacillus. Next day both had large soft swelling but seemed otherwise normal.

Both calves were further injected as follows:—

(*d*.)	On July 12th,	with	15 c.c.		
(*e*.)	„ „ 17th,	„	15 „		
(*f*.)	„ „ 27th,	„	15 „		
(*g*.)	„ Aug. 9th,	„	20 „		
(*h*.)	„ „ 28th,	„	20 „	of a seven days' old broth culture of typhoid bacillus.	
(*i*.)	„ Sept. 13th,	„	20 „		
(*j*.)	„ „ 28th,	„	20 „		
(*k*.)	„ Oct. 17th,	„	25 „		
(*l*.)	„ Nov. 27th,	„	20 „		
(*m*.)	„ Dec. 21st,	„	20 „		

Calf No. 2 was bled on January 21st, and with its serum the following experiments were made:—

1. One guinea pig received ***subcutaneously*** $\frac{1}{4}$ of a gelatine culture of the typhoid bacillus which had been incubated for three days.

2 and 3. Two guinea-pigs each received 1 cubic centimetre of calf's serum *subcutaneously*, and 5–10 minutes afterwards, each received, also *subcutaneously*, ¼ of the same gelatine culture of typhoid bacillus.

4. One guinea-pig received *intraperitoneally* one-fifth of a similar gelatine culture.

5 and 6. Two guinea-pigs each received half a cubic centimetre of calf's serum *intraperitoneally*, and, immediately afterwards, one-fifth of the above gelatine culture, *intraperitoneally*.

From this it will be seen that guinea-pig No. 1 served as "control" for *subcutaneous*, and guinea-pig No. 4 as "control" for *intraperitoneal*, injection. All animals were of about the same weight, 312–334 grammes. The result on the evening of the day of injection was this:—

The *subcutaneous* "control" guinea-pig (No. 1) was ill, quiet, huddled-up in a corner of its cage, and did not feed.

The two *subcutaneous* "serum" guinea-pigs (Nos. 2 and 3) were lively and did not seem affected.

The *intraperitoneal* "control" guinea-pig (No. 4) was very ill, the other two "serum" guinea-pigs (Nos. 5 and 6) were a little quiet.

Next morning the "control" No. 1, was found dead, the other two "*subcutaneous*" guinea-pigs (Nos. 2 and 3) had slight swelling at the seat of injection, were a little quiet, and did not feed well. The *intraperitoneal* "control," No. 4, was also found dead; the other two of this series (Nos. 5 and 6) were still quiet and off their feed.

On the third day the two "*subcutaneous*" guinea-pigs, Nos. 2 and 3, seemed to have quite recovered. One of the "*intraperitoneal*" serum guinea-pigs, No. 5, was found dead; the other, No. 6, seemed quite recovered.

It appears, then, that the germicidal potency of this serum was not of a high order, since both the subcutaneously injected guinea-pigs (Nos. 2 and 3) had swelling at the seat of inoculation and were ill, though they recovered again; and since, of the two intraperitoneally injected guinea-pigs, one died.

That the germicidal potency of the blood serum of these calves was now, January 21st, after so many (12) additional injections of considerable amounts of typhoid bacillus culture, no greater than six months earlier, was also shown by a further experiment, which was a repetition of that just described, except as regards the amount of serum injected. Instead of injecting *subcutaneously* one cubic centimetre, and intraperitoneally 0·5 cubic centimetre, of the serum, I injected 0·5 cubic centimetre *subcutaneously* and 0·25 cubic centimetre *intraperitoneally*. The result was that there was nothing to choose between the "control" animals and the others. All the subcutaneously injected guinea-pigs had next day large swelling, were quiet, not feeding; they gradually recovered, however, under ulceration and sloughing of the skin about the seat of inoculation. The intraperitoneally injected guinea-pigs were all ill in the evening, and were found dead next morning.

From these experiments it follows then that although the serum of the prepared calves did as matter of fact acquire a certain degree of germicidal potency, this was not of a high order and could not be materially increased by a large number of subsequent injections of the calves. On referring to similar experiments described in last year's report as made with the serum of the same calves, it will be seen that at a stage of

immunisation previous to June the germicidal potency of their serum was higher than later on, inasmuch as $\frac{1}{4}$-cubic centimetre of the serum was capable of inhibiting intraperitoneally an otherwise fatal dose of typhoid bacilli. For these reasons I have discontinued this process of immunisation of calves as not leading to the desired result of obtaining serum possessed of high germicidal potency, such, for instance, as could with any degree of confidence be applied, whether protectively or therapeutically, to the human subject.

No. 4.

ROEPORT on SNAKE VENOM in its PROPHYLACTIC RELATIONS with "POISON" of the same and of other sorts; by Dr. A. A. KANTHACK.

APP. B. No. 4. On Snake venom; by Dr. Kanthack.

Calmette* has conclusively shown that, by inoculating rabbits or other animals with gradually increasing doses of cobra poison, it is possible eventually to render them tolerant of injection of remarkably large doses of this venom, *i.e.*, to make them toxin proof or "*gift-fest*." Also he has shown that when they have reached this condition, their serum has acquired so-called antitoxic properties: So that—

(*a*) on mixing such serum in a test tube with a definite quantity of cobra poison, the mixture may be injected into a normal animal without causing death, or even any symptoms at all;

(*b*) this serum has further a preventive action and a curative action as regards this poison.

These observations have been confirmed by Phisalix and Bertrand, Professor Fraser,† of Edinburgh, and others, so that their truth cannot be doubted.

Effect of Cobra Antitoxic Serum upon Poison of Snakes other than the Cobra.

Further, Calmette claims to have demonstrated that the serum of an animal rendered tolerant of cobra poison is capable also of preventing and of curing the effects, practically, *of all other snake poisons*. These observations also have been confirmed by Fraser and others. Thus Calmette came to the conclusion that, so far as snake poison is concerned, a truly specific serum is not required to produce an immunity or to effect a cure. These observations have raised the question as to the validity of the law of specificity which originally had been propounded by Behring. If, it has been said, the serum of an animal rendered proof against cobra venom is capable of neutralising, so to speak, in the body or in a test tube, the poisonous action not only of cobra venom, but also of that of all other snake poisons, then must the rigid notion of specific action of such serum be given up.

The above inference from these results was startling, and it was impossible to accept the results themselves without further control. Meanwhile there is nothing surprising, perhaps, in the fact—and such it is—that the serum of an animal rendered proof against cobra poison should counteract the effects of other colubrine venoms. These toxic substances are chemically closely allied to one another, and they agree more closely still in their physiological action. It was therefore to be expected that a substance which is capable of producing immunity with regard to one form of colubrine poison should also act similarly on all other colubrine poisons chemically allied to it which have the same physiological action. Hence the facts brought out by Calmette, and confirmed by Fraser, startling though they are, do not, so far as colubrine poisons alone are concerned, call in question Behring's law of the specificity of antitoxic or immunising serum. There are, however, snake poisons

* Annales de l'Inst. Pasteur, 1894, vol. viii., No. 5., p. 281 and 1895, vol. ix., No. 4, p. 225; also Le Venin des Serpents. Paris. Société d'Éditions Scientifiques, 1896.

† British Med. Journal, 1895, June 15, p. 1309–12; also Immunisation against Serpents' Venom; an address delivered at the Royal Institute, March 20, 1896.

App. B. No. 4.

On Snake venom; by Dr. Kanthack.

which, both chemically and in their physiological action, differ from cobra venom and from the venom of other colubrine snakes. It is, for instance, stated that at particular seasons of the year the poison of Russell's viper (Daboia) acts as a convulsive poison; *i.e.*, differently from other snake poisons, which produce asphyxia and paralytic symptoms. Thus Wall* has pointed out that the phenomenon is to be attributed to the fact that daboia venom contains two toxic principles, neither of which induces symptoms identical with those of colubrine poisoning. That being so, it would be interesting to know whether, at the particular season above referred to, the anti-cobra serum is active also against daboia venom. At other seasons of the year the daboia poison acts, it is said, like all other snake poisons, and Calmette certainly would claim that it is possible to counteract its effects with anti-cobra serum. Some observers, indeed, including Dr. Brunton and Sir Joseph Fayrer, deny that daboia poison ever acts as a convulsive poison; they maintain that at all seasons it induces symptoms identical with those of cobra poisoning. If that be so, it seems indeed that all snake poisons have the same physiological action, and that they differ only in the amount of the toxic substances contained in them. Dr. D. D. Cunningham,† however, has clearly shown that daboia venom is entirely unlike cobra venom in its nature and in its action; that the former gives rise to well-marked local muscular action at the site of introduction, while normal cobra venom does not. He believes, with Wall, that in daboia poison there are two toxic principles, "one acting as a "direct nervous irritant and the other giving rise to septic changes in the "blood"; and he, too, asserts that the properties of the poison appear to vary at different times of the year. Thus during the rainy season in Calcutta, when moist and warm air prevails, the daboia poison, while retaining its "septic" properties, had lost greatly in its "nerve-irritant" property. Examining other snake poisons, Cunningham comes to the conclusion that all snake venoms are referable to two groups, the venom of the "colubrine" being perfectly distinct in its properties from that of the "viperine."

I have been inclined, on the account of Cunningham's experiments, to accept his statement; and I consider it very desirable to have the action of cobra serum carefully tested on daboia poison, especially as Calmette himself was able to record successful experiments which tend to show that the poison of vipers other than the daboia may be counteracted by the serum of animals inoculated with successive doses of cobra venom. Upon Calmette's view it would be necessary merely to immunise an animal against the most virulent or the strongest snake poison in order to obtain a serum active against all other snake poisons; and for this reason cobra poison should be used in all similar experiments for immunising purposes—it being the strongest of all snake poisons, so far as we know, or at any rate so far as they are accessible to us. Calmette, as a matter of fact, uses a mixture of various snake poisons for the purpose of immunisation. If, however, Cunningham's statements regarding daboia venom are accepted, then we should expect that the serum of an animal rendered immune against cobra poison does not necessarily possess antitoxic action on daboia poison. As I have said, I found no reason why Cunningham's conclusions should be doubted, and, therefore, I noted in Nature,‡ October

* Indian Snake Poisons, &c., 1893.

† Scientific Memoirs by the Medical Officers of the Army of India. 1895. Part ix.

‡ Nature, October 24, 1895, p. 621.

24th, 1895, that "it would be a surprising revelation, if a serum "which is capable of acting as an antidote to a paralysing toxin "(such as cobra poison) were also capable of neutralising the effects "of a toxin of opposite physiological action." It now appears in a paper by Cunningham* which reaches me while these pages are passing through the press, that, as I had ventured to anticipate, "the "serum of animals which have been immunised against cobra venom "has no action whatever as an antidote to daboia venom." He further shows that "an apparently complete immunity against the action of "four times a slightly supra-minimal lethal dose of daboia venom "afforded no protection whatever against a slightly supra-minimal lethal "dose of cobra venom." I do not believe, therefore, that on the basis of Calmette's observations on snake venom we are justified in arguing against the specificity of anti-toxic serum; on the other hand, I consider that Cunningham's experiments offer the strongest support to our old belief.

By experiments of my own I have confirmed the preventive action of anti-cobra serum towards rattlesnake venom, but have not been in a position to extend my observations on other snake poisons, because they, so far, have not been accessible to me.

The Nature of the Immunity of certain Snakes to certain Snake Poisons.

It is a curious point that, although one kind of snake poison immunises, as it appears, against almost all others, and although the serum of an animal strongly immunised against cobra poison counteracts almost all other forms of snake poison, nevertheless poisonous snakes are, generally speaking, not resistant to the poison of other species, *i.e.*, no more resistant than many other cold-blooded animals. This has been demonstrated by Waddell,† and I am in a position to confirm it with regard to a young rattlesnake, which I had kept in my laboratory for nine months. It was then inoculated with a comparatively large dose of cobra poison (5 mg.) administered subcutaneously by means of a hypodermic syringe. The result was that the animal died after three days. A large dose was used, in this instance, because previous experiments performed in India had shown that many reptiles and amphibia are comparatively resistant to cobra poison, whether they themselves are poisonous or not. The partial resistance of the rattlesnake to this poison, is to my mind, not due to the poison which the rattlesnake itself secretes, and which, according to some observers, is frequently swallowed (Fraser), but is probably due to the same unknown conditions which render the Varanus bengalensis and the Varanus salvator such resistant animals. The insusceptibility of some poisonous snakes to poisons of other snakes, belonging to different species, constitutes a curious paradox, and for that reason I cannot accept Fraser's explanation, that a snake acquires immunity against its own poison by swallowing its own poison. We know from Fraser's experiments, questioned, however, by both Calmette and Cunningham, that, as Ehrlich had already shown with reference to abrin and ricin,‡ an animal can be rendered toxin proof by feeding it on snake poison, and that thereby antitoxic properties are imparted to its serum. Experiments of my own fully confirm Fraser's observations and show that it is easy to immunise animals by feeding them with cobra poison. Thus, rats fed for five days on 20 mg. of cobra venom daily, *i.e.*,

* Report on the Results of Experiments on the Action of various reputed Antidotes to Snake Venom, 1895–96, Calcutta.

† Scientific Memoirs by Med. Officers of the Army of India, 1889, iv., p. 59.

‡ Deutsche Med. Wochenschr, vol. xvii., No. 44, &c.

100 mg. altogether, a month later withstood the effects of a subcutaneous injection of several times the lethal dose of this venom, and small kittens fed for some time with large doses of the venom acquired an extraordinary immunity from cobra poison administered under the skin. This is well shown by the following notes. A kitten was fed for five successive days with 20 mg. of cobra venom daily; a week later it resisted injection of a whole milligramme; after 16 days' rest it was again fed for 5 days with 20 mg. and after 3 days' rest it easily bore injection of 2 mg.; it then rested 5 days, and was now fed for 5 successive days with 40 mg., when it readily tolerated injection of 3 mg. It had a week's rest and then feeding was recommenced, and continuing in this manner it soon bore 10 mg. with so little bad effect, that undoubtedly it had acquired an immunity against a much larger dose. It is erroneous, therefore, to question Fraser's observations.

Hence, if Fraser's explanation—*i.e.*, that venomous snakes acquire an immunity against their own poison by swallowing their own poison—were correct, then on the basis of Calmette's fundamental experiments (*a*) a venomous snake should be insusceptible, or certainly less susceptible than other non-poisonous snakes and reptiles or amphibia, to other snake poisons, which it is not; and (*b*) its serum should possess antitoxic powers. As far as the latter point is concerned, Fraser states that the serum of a normal poisonous snake does, indeed, possess such powers; but experiments of my own on this point, performed in India some years ago,* proved negative, or were certainly not positive. These have recently been confirmed by Cunningham. To them I shall allude later. Fraser's assumption that a snake obtains self-protection by swallowing its own poison is further rendered improbable by the fact that some of the innocent snakes are very, almost absolutely, resistant against cobra poison; indeed, it seems from the few experiments which have so far been made (which are not always free from errors), that there is likely to be found some common principle on which we can explain the immunity of poisonous and non-poisonous snakes, without assuming for the former continued ingestion of venom. Waddell's experiments and my own show, in regard of venomous snakes, that cobra venom is rapidly fatal to two species of the green tree viper (Trimeresurus) and to a species of Crotalus. And from the less definite experiments of others, collected by Waddell, it appears that cobra venom is inoperative on Daboia russellii, doubtfully operative on Bungarus fasciatus and cœruleus, and is fatal to Echis carinata; also that the cobra can resist the bite of the Daboia and Bungarus. Of the innocent snakes, robust specimens of Simotes and of Ptyas or Zamenis mucosus (rat-snake) are very insusceptible to cobra poison.† With regard to the Zamenis Cunningham's experiments are conclusive, for a specimen weighing 720 grammes easily resisted 100 mg. of cobra poison. Snakes as a group, therefore, must be regarded as relatively resistant to cobra poison, whether they be venomous or harmless.

Although I have not been able to prove that fresh cobra serum has any antitoxic power against cobra venom *in vitro*, I have obtained evidence that the blood of the Varanus bengalensis possesses a certain power of neutralising cobra venom, as will be seen from the following experiments, made in 1891:—*

(1.) m. iii. of dilute cobra poison + 2 c.c. of Varanus blood injected into a hen. Died after 28 hours; control animal died after 35 minutes.

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* A. A. Kanthack. Journal of Physiology, vol. xiii., Nos. 3 and 4, 1892, p. 290.
† Waddell and D. D. Cunningham, op. cit.

(2.) m. ix of the same poison olution + 5 c.c. of Varanus blood injected into a hen. Died after 1 hour; control animal died quickly.

(3.) 5 c.c. of Varanus blood + 28 hours later m. iii. of the cobra poison solution injected into a hen. Died after 2¼ hours; control animals died after 70 and 30 minutes.

(4.) 5 c.c. of Varanus blood and 48 hours later m. v. of the cobra poison solution injected into a hen. Died after 1 hour; control animals died after 15 and 20 minutes.

It is evident, therefore, that this power of the blood of the Varanus to hinder the action of cobra venom could not have been due to an immunisation of the animal produced by swallowing the poison. Cunningham* in his most recent communications relates most interesting experiments which, besides confirming my own observations on the action of the serum of normal cobras, show that the serum of cobras which have been treated with excessive doses of cobra venom, instead of acquiring thereby protective or immunising property, may for some time contain enough unaltered venom to render such serum capable of causing fatal intoxication in susceptible animals. I find, therefore, considerable difficulty in explaining these various observations, or in reconciling the various contradictions. I may mention that Fayrer, Cunningham, and others, have shown that the Varanus salvator is endowed with a relative insusceptibility to cobra poison, and Cunningham, indeed, concludes that although snakes and other cold-blooded animals appear to be relatively insusceptible to the action of cobra venom, such immunity is by no means a general property of the Lacertilia; Calotes, for instance, being highly susceptible. The Batrachia, however, possess generally a relative insusceptibility. From these facts it seems to be illogical to explain the immunity of venomous snakes by assuming that they immunise themselves by repeatedly swallowing their own poison.

Neutralising effect of Chlorinated Lime on Cobra Venom.

Calmette† stated in 1894, (1) that it is possible to neutralise the effects of cobra poisoning by means of injections of chlorinated lime (bleaching powder), either around the area of inoculation or into more distant parts of the experimental animal; (2) that by means of repeated injections of this lime compound it is possible to immunise the animal against cobra poison; (3) that by means of such injections it is possible to impart to the serum of the experimental animal antitoxic properties, at any rate *in vitro*. In a previous paper Calmette‡ had stated that the effects of cobra poisoning could be inhibited and removed by injections around the seat of inoculation, or into distant parts, of chloride of gold. But I then showed§ that this mode of treatment is untrustworthy, for I never succeeded in saving a single animal by means of distant or remote injections of chloride of gold. That the serum should acquire antitoxic powers against cobra poison by means of continued injection of chlorinated lime appeared to me surprising, and calculated to shake our belief in the soundness of Behring's law. I therefore undertook certain experiments as to the *curative* and as to the *protective* effect of chlorinated lime in this connexion.

* Report on the Results of Experiments, &c., 1895–96, pp. 18, 19.
† Annales de l'Inst. Pasteur, vol. viii., 1894, No. 5.
‡ Annales de l'Inst. Pasteur, vol. vi., 1892, No. 3.
§ A. A. Kanthack. Lancet, June 11, 1892.

Rabbit i.
1 mg. cobra poison subcutaneously injected at 12.22 p.m.
12.45–12.50. 30 c.c. of chlorinated lime (strength 1 in 60) injected all round the seat of inoculation and in both legs.

The animal survived, and apparently without any bad symptoms. The control animal died after 3½ hours.

Rabbit ii.
2.55 p.m. 2 mg. cobra poison injected under the skin of the abdomen.
3.5 p.m. 10 c.c. of chlorinated lime (strength 1 in 60) injected in back.
3.10 p.m. 5 c.c. " " " " around seat of inoculation.
3.12 p.m. 5 c.c. " " " " " "
3.15 p.m. 10 c.c. " " " " in thighs and chest.

The animal died at 4.30; death, therefore, was hardly delayed, although the treatment was begun very early.

These two experiments show that this method of *curative* treatment is not trustworthy, and after a few more failures I desisted from further testing it. *In vitro*, it must be remarked, this lime compound is capable of removing the toxic power of cobra poison in a most efficacious manner, but *in vivo* it is of little use.

Observations were then made to test the immunising power, *i.e.*, the *protective* effect of chlorinated lime.

Rabbit i.
May 26, 1895. 10 c.c. of chlorinated lime (strength 1 in 60) injected subcutaneously.
May 27, 1895. " " " " "
May 28, 1895. " " " " "
May 29, 1895. " " " " "
May 30, 1895. " " " " "
May 31, 1895. 1 mg. of cobra poison injected at 3.15 p.m. Animal died at 5.30 p.m. Control animal died in 3½ hours.

This experiment was repeated on five further occasions, and invariably it was followed by a similar result. I performed the inoculations in the manner laid down by Calmette, and in view of my own failures I am unable to explain his results. I find, moreover, that Bertrand and Cunningham have been equally unsuccessful in their repetitions of Calmette's experiments. It would seem impossible, then, in this manner, to establish an immunity.

Production of Antitoxic Serum.

A series of observations were then made with a view of ascertaining whether it is possible to impart antitoxic properties to the *serum* of a rabbit by inoculating it repeatedly with *chlorinated calcium.*

Rabbits i. and ii.
June 5, 1895. 5 c.c. chlorinated lime (strength 1 in 60) injected subcutaneously.
June 6, 1895. " " " " "
June 7, 1895. " " " " "
June 8, 1895. " " " " "
June 9, 1895. " " " " "
June 9, 1895. Rabbit i. was bled, the serum separated, and 10 c.c. of this serum were mixed in a test-tube with ·5 mg. cobra poison.
June 11, 1895. This mixture was injected into a guinea-pig at 10.35 a.m.; it died at 11.25 a.m. Into a control guinea-pig a mixture of 10 c.c. of water with ·5 mg. of cobra poison was injected at 10.35 a.m.; it died at 11.20 a.m.
June 11, 1895. Rabbit ii. was bled, the serum separated, and 10 c.c. of the serum were mixed with ·5 mg. cobra poison.
June 12, 1895. This mixture was injected into a guinea-pig at 11 a.m.; it died about 12. Control animal also died in an hour.

Exactly the same experiment was made on four additional rabbits, and in all cases with the same result. Hence it would seem impracticable to render the serum of the rabbit antitoxic by this procedure and I maintain that, as long so Calmette's results remain unconfirmed, they, cannot be used as arguments against the specificity of the antitoxic serum.

On the other hand, I find, as he did, that it is possible to produce an antitoxic serum by means of specific immunisation of the rabbit, *i.e.*, by administration of the *cobra poison itself.* To establish a tolerance against this poison, patience alone is required; the slightest haste may undo a month's or three months' work. The method of immunisation by means of gradually increasing doses is so well known, and I have described it elsewhere,* that it will not be necessary to describe it again here. I may, however, give an example to show how soon the antitoxic property, even though in an imperfect measure, appears in the serum.

Rabbit i.	June 17, 1895.	Received	·125 mg.	cobra	poison subcutaneously.
	June 22, 1895.	„	„	„	„
	June 26, 1895.	„	„	„	„
	June 29, 1895.	„	„	„	„
	July 1, 1895.	„	„	„	„
	July 8, 1895.	„	·25 mg.	„	„
	July 13, 1895.	„	„	„	„
	July 17, 1895.	„	„	„	„
	July 20, 1895.	„	„	„	„
	July 22, 1895.	Animal was bled, and serum separated.			

8 c.c. of this serum was mixed with ·5 mg. of cobra poison and injected into a guinea-pig; it died after two hours. A control animal of equal weight was injected with 8 c.c. of normal serum and ·5 mg. of poison; it died after one hour. There was, therefore, already a well-marked antitoxic action, although the rabbit had only received 1·625 mg. of cobra poison.

Another animal had been treated in the following manner:—

Rabbit ii.	June 24, 1895.	Received	·125 mg.	cobra	poison subcutaneously.
	June 29, 1895.	„	„	„	„
	July 2, 1895.	„	„	„	„
	July 5, 1895.	„	„	„	„
	July 7, 1895.	„	„	„	„
	July 16, 1895.	„	·25 mg.	„	„
	July 21, 1895.	„	„	„	„
	July 25, 1895.	„	„	„	„
	July 28, 1895.	„	„	„	„
	Aug. 4, 1895.	„	·5 mg.	„	„
	Aug. 9, 1895.	„	„	„	„
	Aug. 15, 1895.	„	„	„	„
	Aug. 20, 1895.	„	„	„	„
	Aug. 25, 1895.	„	„	„	„
	Aug. 30, 1895.	„	„	„	„
	Sept. 4, 1895.	„	„	„	„
	Sept. 9, 1895.	„	„	„	„
	Sept. 17, 1895.	„	„	„	„
	Sept. 24, 1895.	„	„	„	„
	Oct. 2, 1895.	„	„	„	„
	Oct. 11, 1895.	„	2·0 mg.	„	„
	Oct. 18, 1895.	„	1·0 mg.	„	„
	Oct. 27, 1895.	„	3·0 mg.	„	„

* Journal of Phys., vol. xiii., Nos. 3 and 4, 1892, p. 286–7.

The animal was bled on July 21, 1895, and the serum having been separated, ·5 mg. of cobra poison + 8 c.c. of the serum killed a guinea-pig in two hours. The control animal died in one hour.

Rabbit ii. was again bled on November 17, 1895:—

(*a.*) 1·0 mg. of cobra poison + 1 c.c. of its serum killed a guinea-pig in 40 minutes.

(*b.*) 1·0 mg. of cobra poison + 2 c.c. of its serum killed a guinea-pig in 50 minutes.

(*c.*) ·5 mg. of cobra poison + 2 c.c. of its serum killed a guinea-pig in two hours.

(*d.*) ·5 mg. of cobra poison + 5 c.c. of its serum had no effect on a guinea-pig.

A third rabbit had been treated as follows:—

Rabbit iii.	June 17, 1895.	Received	·125 mg.	cobra poison	subcutaneously.
	June 22, 1895.	"	"	"	"
	June 26, 1895.	"	"	"	"
	June 29, 1895.	"	"	"	"
	July 1, 1895.	"	"	"	"
	July 9, 1895.	"	·25 mg.	"	"
	July 14, 1895.	"	"	"	"
	July 18, 1895.	"	"	"	"
	July 21, 1895.	"	"	"	"
	July 23, 1895.	"	"	"	"
	Aug. 4, 1895.	"	·5 mg.	"	"
	Aug. 9, 1895.	"	"	"	"
	Aug. 15, 1895.	"	"	"	"
	Aug. 20, 1895.	"	"	"	"
	Aug. 25, 1895.	"	"	"	"
	Aug. 30, 1895.	"	"	"	"
	Sept. 4, 1895.	"	"	"	"

July 23, 1895. ·5 mg. of cobra poison + 8 c.c. of the serum of this rabbit killed a guinea-pig in two hours.

August 3, 1895. ·8 mg. of cobra poison + 8 c.c. of its serum killed a guinea-pig in four hours (control animal of the same weight dying in 30 minutes).

A more successful antitoxic serum was obtained from animals treated in this manner:—

Rabbits iv., v., vi.	Oct. 30, 1895.	Each received	·25 mg.	of cobra	poison subcutaneously.
	Nov. 2, 1895.	"	"	"	"
	Nov. 6, 1895.	"	"	"	"
	Nov. 9, 1895.	"	"	"	"
	Nov. 13, 1895.	"	·5 mg.	"	"
	Nov. 18, 1895.	"	"	"	"
	Nov. 22, 1895.	"	"	"	"
	Nov. 30, 1895.	"	"	"	"
	Dec. 7, 1895.	"	1·0 mg.	"	"
	Dec. 14, 1895.	"	"	"	"
	Dec. 21, 1895.	"	"	"	"
	Dec. 28, 1895.	"	"	"	"
	Jan. 4, 1896.	"	2·0 mg.	"	"
	Jan. 13, 1896.	"	"	"	"

One animal was bled on January 14, 1896, and the serum of its blood separated. ·125 mg. of cobra poison + 1·5 c.c. of its serum had no effect on a guinea pig, whereas the control animal of the same weight died in 4 hours 20 minutes.

The best antitoxic serum was obtained from the following rabbit:—

Rabbit vii.

Jan. 7, 1895.	Received	·25 mg.	cobra poison	subcutaneously.
Jan. 10, 1895.	„	„	„	„
Jan. 23, 1895.	„	„	„	„
Jan. 29, 1895.	„	„	„	„
Feb. 5, 1895.	„	„	„	„
Feb. 12, 1895.	„	·5 mg.	„	„
Feb. 18, 1895.	„	„	„	„
Feb. 25, 1895.	„	„	„	„
Mar. 4, 1895.	„	„	„	„
Mar. 10, 1895.	„	„	„	„
Mar. 17, 1895.	„	„	„	„
Mar. 25, 1895.	„	„	„	„
Mar. 31, 1895.	„	„	„	„
April 2, 1895.	„	„	„	„
April 8, 1895.	„	1·0 mg.	„	„
April 14, 1895.	„	„	„	„
April 22, 1895.	„	„	„	„
April 29, 1895.	„	„	„	„
May 5, 1895.	„	„	„	„
May 12, 1895.	„	1·5 mg.	„	„
May 19, 1895.	„	„	„	„
May 26, 1895.	„	„	„	„
June 2, 1895.	„	„	„	„
June 9, 1895.	„	2·0 mg.	„	„
June 17, 1895.	„	„	„	„
June 23, 1895.	„	„	„	„
June 30, 1895.	„	„	„	„
July 7, 1895.	„	„	„	„
July 21, 1895.	„	„	„	„
July 28, 1895.	„	„	„	„
Aug. 4, 1895.	„	„	„	„
Aug. 11, 1895.	„	„	„	„
Aug. 24, 1895.	„	3·0 mg.	„	„
Sept. 8, 1895.	„	„	„	„
Sept. 24, 1895.	„	„	„	„
Oct. 1, 1895.	„	„	„	„
Oct. 12, 1895.	„	4·0 mg.	„	„
Oct. 21, 1895.	„	5·0 mg.	„	„
Oct. 30, 1895.	„	„	„	„
Nov. 10, 1895.	„	6·0 mg.	„	„
Nov. 21, 1895.	„	„	„	„
Dec. 12, 1895.	„	„	„	„
Dec. 22, 1895.	„	„	„	„
Jan. 2, 1896.	„	7·0 mg.	„	„
Jan. 13, 1896.	„	8·0 mg.	„	„
Jan. 20, 1896.	„	„	„	„
Feb. 23, 1896.	„	„	„	„

In a little over a year, therefore, the animal received 113·75 mg. of cobra poison. The animal was bled on October 14, 1895, and the serum of its blood separated. 1 c.c. of this serum + ·1 mg. of cobra poison had no effect on a guinea-pig, whereas the control animal of the same weight died in 20 minutes.

On November 11, 1895, rabbit vii. had two young ones, and on December 10, 1895, on testing their immunity it was found that they bore ·4 mg. of cobra poison without ill effects, an amount which killed an adult rabbit in 36 hours, and a young rabbit three months of age in three hours.

These observations show that it is possible, by means of inoculation of cobra poison, to obtain a serum with some specific antitoxic quality, although I must confess that working with the rabbits in London in this manner, with insufficient accommodation for the animals, does not lead to very satisfactory results.

A better method of obtaining a specific anti-cobra serum consists in graduated inoculations of mixtures *in vitro* of *cobra poison and chlorinated calcium*, as recommended by Calmette. It will suffice to give an account of one experiment to demonstrate the method.

Rabbits x. and xi.	April 9, 1895.	Each received subcutaneously 2 mg. of poison :— + 5 c.c.	chlorinated lime	(strength 1 in 60).
	April 15, 1895.	+ 2·0 c.c.	"	"
	April 20, 1895.	+ 1·5 "	"	"
	April 25, 1895.	+ 1·0 "	"	"
	April 30, 1895.	+ ·5 "	"	"
	May 5, 1895.	+ ·4 "	"	"
	May 10, 1895.	+ ·3 "	"	"
	May 18, 1895.	+ ·2 "	"	"
	May 25, 1895.	+ ·1 "	"	"
	June 1, 1895.	+ 0·0 "	"	"
	June 17, 1895.	+ 0·0 "	"	"

The animals were bled on June 27, 1895, and the serum of their blood separated.

(*a.*) ·5 mg. of cobra poison + 5 c.c. of this serum was allowed to stand for 24 hours, and then injected into a guinea-pig; the animal remained alive and well. Five days later it was again injected with ·5 mg. of poison; the animal lived for over 12 hours, whereas the control guinea-pig died in one hour.

(*b.*) 1 mg. of cobra poison + 5 c.c. of this serum was injected at once into a guinea-pig; the animal remained alive and well.

This must be considered a good result, remembering the large dose of cobra poison used. But a curious fact is this, that on injecting six days later ·6 mg. into the same animal, it died in about one-and-a-half hours, the control animal dying in 40 minutes. Obviously a lasting immunity had not been established. Although this animal had been treated for only three months, and had received no more than 22 mg. of cobra poison, its serum was more potent than that of Rabbit vii. after the latter had been treated for nine months, and had received about 70 mg. of poison For though 1 c.c. of serum from Rabbit vii. neutralised ·1 mg. of cobra venom, 3 c.c. were incapable of counteracting twice that amount.

From these experiments, then, it appears that, however imperfect they are as compared with those of Calmette and Fraser, there is no real difficulty in obtaining a serum which has a preventive or neutralising action on cobra poison, if the cobra poison itself be used for the purpose of immunisation.

Inhibitory influence of different Antitoxic Sera upon Cobra Venom.

By way of testing Calmette's statement that not only does cobra serum exert an inhibitory influence on the cobra poison, but that other sera exhibit a like influence on this venom, I instituted two series of experiments.

(*a.*) To begin with, I take Calmette's statement that animals which have received subcutaneous injections of cobra blood can subsequently bear considerable doses of the venom, since as already mentioned,

Fraser, to some extent, agrees with him in the view that cobra serum from the normal cobra possesses antitoxic powers as to cobra venom.

Calmette's own experiments, *i.e.*, those which he quotes, are far from convincing (Annales, 1895, p. 236, Exp. 3 and 4), because in one case a guinea-pig treated with cobra blood succumbed to ·1 mg. of cobra poison in two hours, and in another case a guinea-pig succumbed to ·2 mg. in an hour, having previously resisted ·1 mg. This animal, however, was a large guinea-pig, and Calmette, as will be seen in this case, worked with fairly small doses, and I have noticed that occasionally susceptible animals will resist small lethal doses to an unequal degree; so that there is room for numerous fallacies in proceeding in this manner. Fraser's results are no more convincing than Calmette's, he worked with minimal doses.

To demonstrate the possibility of fallacies thus arising, I performed a series of 13 experiments. For convenience I employed rabbits, which I was in process of immunising, but as they had been under treatment for a very short time (only 2–3 weeks), their serum could not have been of much antitoxic value when I bled them to obtain serum. Four sets of experiments were made.

Set 1.—A solution of dried cobra poison was made of such strength that a young rabbit, weighing less than 500 grms., succumbed to a subcutaneous injection of 1 c.c., in seven hours. Three fresh rabbits were taken and treated as follows:—

Rabbit 1 received ·75 c.c. of the cobra poison solution + 1·5 c.c. of the above serum. Survived.

Rabbit 2 received ·75 c.c. of the cobra poison solution + 1·5 c.c. of water. Died after four hours.

Rabbit 3 received ·75 c.c. of the cobra poison solution alone. Survived.

All animals were of the same body weight.

Set 2.—The same cobra poison solution was used, and three other rabbits were taken:—

Rabbit 4 received ·75 c.c. of poison solution + 1·5 c.c. of the above serum. Died after 24 hours.

Rabbit 5 received ·75 c.c. of poison solution + 1·5 c.c. of water. Died after 72 hours (emaciated).

Rabbit 6 received ·75 c.c. of poison solution alone. Died after 48 hours.

Set 3.—The same cobra poison solution was used, and three other rabbits of equal size and weight were used:—

Rabbit 7 received ·5 c.c. of poison solution (alone, without serum). Survived.

Rabbit 8 „ ·5 c.c. „ „ „ Survived.

Rabbit 9 „ ·5 c.c. „ „ Died after 18 hours.

Set 4.—The same cobra poison solution was used, but rats were employed instead of rabbits; rats being animals which are much more susceptible to cobra poison than rabbits:—

Rat 1 received 1 c.c. of poison solution + 1 c.c. of the serum. Died in 3½ hours.

Rat 2 received 1 c.c. of poison solution + 1 c.c. of water. Died in 1½ hours.

Rat 3 received 1 c.c. of poison solution alone. Died in 2½ hours.

Rat 4 „ 1 c.c. „ „ „ „ 3½ „

The uncertainty of action of small doses of cobra poison is also well shown by the following Table, which gives the dose of cobra poison used and the time it required to kill 1 kilogramme of guinea-pig with that dose.

Amount of Poison used per 1 kilog.	Time required to produce a Lethal Effect.	Amount of Poison used.	Time required to produce a Lethal Effect.
1·5 mg.	50 minutes.	·6 mg.	120–200 minutes.
1·1 mg.	50–125 minutes.	·5 mg.	260 minutes.
1·0 mg.	90 minutes.	·5 mg.	60–140 minutes.
·8 mg.	140 „	·375 mg.	265–460 „
·75 mg.	140 „	·25 mg.	60 minutes.
·7 mg.	110 „		

It is evident, from these data, that working with very small doses of cobra poison curiously contradictory results may be obtained; so that I am not willing to allow Calmette's or Fraser's conclusions until there is a greater uniformity in the observations.

My own experiments with *fresh* serum obtained from the cobra itself were made in India, and have been recorded in the Journal of Physiology for 1892. I may be allowed to copy from that paper: "Four experiments "were made, and in each the mixture (of diluted cobra poison solution "and serum) was allowed to stand 24 hours before being injected into "a rabbit."

Experiments.	Proportions of Serum and Poison.	Result.	Control.
XIII. -	5 c.c. of serum + m. xv. of Poison *a*.	Died in 12 hours	Died in 6 hours.
XIV. - -	5 c.c. of serum + m. iv. of Poison *b*.	Died in 2½ hours	Died in 50 mins.
XV. -	5 c.c. of serum + m. i. of Poison ii.	Alive and well -	Died in 5·34 hrs.
XVI. - -	9 c.c. of serum + m. ii. of Poison ii.	Died in 4½ hours	Died in 1–2¼ hours.

"At first sight it appears that the serum actually has an appreciable "influence over the toxic power of cobra poison. It was therefore "necessary to test whether or no this effect is due to so great a dilution "as the addition of 5 to 9 c.c. of serum to a few minims implies. There "can be no doubt, from the following experiments, that the above "results are not (necessarily) due to any inherent power of the serum "for with plain water the same delay in the action of the poison may be "obtained."

Experiments.	Proportions of Water and Poison.	Result.	Control.
XVII. -	10 c.c. of water + m. ii. of Poison ii.	Survived -	Died in 1–2¼ hours.
XVIII. -	5 c.c. of water + m. iii. of Poison ii.	Died in 3 hours	Died in 1 hour.
XIX. -	5 c.c. of water + m. iii. of strong poison.	Died in 1 hour -	Died in 30 mins.

There can be no doubt then that dilution of cobra poison will frequently delay its action, and that this is a point that must be remembered while working with minimal doses. Cunningham,* however, denies this, and, contrasting cobra poison with daboia poison, says "dilution of "minimal lethal doses of cobra venom in no way affects their potency, "whilst dilution of minimal lethal doses of normal daboia venom "ordinarily renders them incapable of causing death." Delay of death in my own experiments by no means always occurs; nevertheless the fact that it may occur at all is important. A few further observations may be quoted here to show the inconstancy of small or minimal doses, whether diluted or not.

APP. B. No. 4.

On Snake venom; by Dr. Kanthack.

Rabbit i. 1 c.c. of a cobra poison solution + 19 c.c. of ·75 per cent. NaCl. solution injected into the ear vein; animal died after 1¼ hours.

Rabbit ii. 1 c.c. of the same poison solution undiluted injected into the ear vein; animal was very ill, but subsequently recovered.

Rabbit iii. 1 c.c. of the same poison solution diluted with 19 c.c. of water injected into the ear vein; animal died after an hour.

Rabbit iv. 1 c.c. of the same poison solution undiluted injected into the ear vein; animal died after an hour.

This series of observation may seem to support Cunningham's views; but I must maintain that there is no constancy in the results obtained from a long series of experiments. Without laying undue stress on my own observations, I may claim that unless a large number of positive experiments can be brought forward, there is need for hesitation in accepting a result based on inoculation of small doses of cobra poison. For the present, then, the question of antitoxic or preventive action of normal cobra serum must be left still undecided. But I may repeat that Cunningham working in Calcutta with normal and sound cobras has been able to confirm my earlier observations.

(*b.*) A much more important question, raised by Calmette, is the direct action *in vitro* of various kinds serum of immunised animals on cobra poison and on other poisons. Calmette† records numerous observations to show that the neutralising or antitoxic power of a serum is by no means necessarily specific. I give his results in a tabular form. In the first column I have placed the poisons which were tested; in the succeeding columns the results, positive or negative, according as to whether in each instance the poison was neutralised or not by the several sera.

Virus employed.	Cobra Serum.	Diphtheria Serum	Tetanus Serum.	Abrin Serum.	Rabies Serum.	Normal Human Serum.	Ascitic Fluid.	Typhoid Serum.	Cholera Serum and Erysipelas Serum.	Prodigiosus, Bact. Coli, and B. Subtilis Serum.	Anthrax Serum.
Abrin	+	−	−	+	−	−	−	−	. .	. .	−
Cobra poison	+	−	+	+	+	−	−	−	+	−	. .
Diphtheria toxin	−	+	. .	+	−	+	+	−	. .	. .	. .
Anthrax bac.	. .	. .	. .	−	. .	. .	. .	. .	. .	. .	+
Ricin	−	−	−	+	−	+	+	−	. .	. .	. .
Tetanus toxin	−	−	+	−	−	−	−	−	. .	. .	. .

* Scientific Memoirs by Medical Officers of the Army of India, &c., 1895, part ix. p. 46.

† Annales de l'Inst. Pasteur, vol. ix., April, 1895.

App. B. No. 4.
On Snake venom; by Dr. Kanthack.

This table gives us Calmette's results in a form allowing of easy comparison. But it is hopeless to attempt to draw inference from it. Thus, "Cobra serum" has no action on tetanus-toxin, but "Tetanus serum" has a marked action on cobra poison; and other examples of a similar perversity will be readily found on consulting the original paper. Again, Calmette states that animals immune against abrin are also immune against anthrax and *vice versâ*, and yet neither the "Anthrax" nor the "Abrin serum" are of any use against abrin or anthrax respectively. So that he gives us in his original paper a series of paradoxes. In fairness to Calmette it must be said that he himself does not give up his belief in the specificity of antitoxic serum, because, as he admits, "we know of no single serum capable of neutralising several poisons "equally well and thoroughly." No doubt had he worked with larger doses this would have come out much more strongly. Thus, for instance, for cholera Pfeiffer has shown that "Normal goat's serum" has a preventive action both on the living cholera and the living typhoid virus, but that a "Cholera serum" of the goat is thousand times more active against the cholera vibrio, but no more active against the typhoid bacillus than "Normal goat's serum"; and *mutatis mutandis*, the same applies to "Typhoid serum" (goat). This agrees with the experience of most observers.

But when we come to look into Calmette's statements, we find that in one or two instances equally good observers differ from him; so that there is to begin with an absence of uniformity. Thus Ehrlich emphatically denies the existence of any reciprocal action between abrin and "Ricin serum" or between ricin and "Abrin serum," and he certainly deserves to be heard on this question. I may also mention that Roux (Annales de l'Inst. Past., 1894, p. 722, &c.) has asserted that "Diphtheria serum" is capable of counteracting the effects of abrin. Ehrlich has tested this, and has contradicted the assertion through Pfeiffer (Zeitschr. f. Hygiene xix., p. 90); Calmette also obtained negative results in this connexion.

I myself have made so far only a small number of experiments, and, working with doses less likely to lead to fallacies, hitherto have obtained none of Calmette's results. Wherefore I am disposed to maintain that in most cases the reciprocal action is very imperfect, and certainly not sufficiently established. A real effect, apparently, can only be obtained with specifically prepared serum. My experiments are, however, still in progress, and what I now say must not be regarded as final.

Guinea-pig 1. Injected with ·5 mg. cobra poison + ·75 grm. dried "Tetanus serum" dissolved in 2 c.c. of NaCl solution (B.I.P.M.).* Died in two and half hours; two control animals of the same weight died in one and half and two and half hours respectively.

Guinea-pig 2 (3½ ozs.). Injected with ·25 mg. cobra poison + ·75 grm. dried "Tetanus serum" (B.I.P.M.). Died in two hours; two control animals of the same weight died in 47 minutes and one hour respectively.

Guinea-pig 3 (5½ ozs.). Injected with ·125 mg. cobra poison + ·5 grm. dried "Tetanus serum" (B.I.P.M.). Died in two and a half hours; control animal of same weight died in four and a half hours.

Guinea-pig 4 (5½ ozs.). Injected with ·125 mg. cobra poison + 1·5 c.c. of anti-cobra serum. Survived.

* British Institute of Preventive Medicine.

From these experiments it appears that the tetanus antitoxic serum had no special value, although large doses were given, whereas the anti-cobra serum readily neutralised the cobra poison.

Guinea-pig 5 (11¼ ozs.). Injected with ·25 mg. of cobra poison + 3 cc. of "Coli serum." Died in two hours; control animal died in one and a half hours.

Guinea-pig 6. Injected with ·25 mg. of cobra poison + 5 c.c. of "Diphtheria serum" (Klein). Died in one and a half hour; control animal died in one and a quarter hours.

Guinea-pig 7. Injected with ·25 mg. of cobra poison + 5 c.c. of "Diphtheria serum" (Biggs). Died in two hours; control animal died in the same time.

Guinea-pig 8. Injected with ·25 mg. of cobra poison + 5 c.c. of "Cholera serum." Died in three hours; three control animals died in four, three, and two and half hours respectively.

Unfortunately, through a loss of my animals during the extremely hot summer of 1895 while they were in process of immunisation, I have not been able to complete any experiments with "Ricin" and "Abrin serum."

From these few experiments I am not inclined to believe in a true reciprocal action of sera obtained from different sources. The observations of Calmette may be compared with those of Buchner and Hankin on the so-called "alexins." The latter showed that the serum, blood, or lymphoid organs of many animals contain feebly bactericidal substances, the presence of which in the body is often not even in any direct relation to the natural immunity of the animal, and may be in an inverse relation to it. Similarly it is quite possible that the normal blood, serum, or organs of animals may also contain antitoxic substances, which, in a test tube, are capable of destroying the action of certain living poisons, or which, after injection into the tissues, together with the toxin of the microbes, may prevent or delay the absorption of such toxin, so that the tissues are enabled to resist the toxin. But it will be readily seen from what has been said before, that these antitoxic substances (in the blood for instance) bear no necessary relation to the natural immunity of the animal, so that often it may be found that the serum of a highly susceptible animal has marked antitoxic powers. The specific immunity produced by specific inoculation cannot be due to the gradual development of these alexins or of natural antitoxins. This is clearly shown by Pfeiffer's experiments quoted above, namely, that the serum of a cholera immune goat has an enormous destructive power over choleraic virus, although its action on the typhoid virus is altogether feeble, is the same indeed as that of normal goat serum. We cannot assume, then, that we have a primary alexin, or a primary antitoxin, which by specific immunisation remains in part unaltered, and is in part specialised into a more active specific alexin, or antitoxin. Such a view is untenable. This, however, is not the place to discuss theories of immunity, and I will only state that a lasting and highly marked immunity can only be obtained by specific treatment; that a really powerful serum also can only be obtained by specific treatment; and that the bactericidal or antitoxic effects produced in the body by such treatment are not due to a higher development of alexins or antitoxins naturally possessed by the animal body, but are due to absolutely newly acquired specific properties, which co-exist independently of those natural properties.

As an illustration of natural destructive mechanisms, I may mention the action of pancreatic digestion, and the destructive action of the liver cells, on cobra poison. The former I have described on a former

App. B. No. 4.
On Snake venom; by Dr. Kanthack.

occasion;* the latter has already been dealt with by Calmette, who showed that an animal was capable of resisting large doses of cobra poison injected into the large intestine. These experiments I have been able to confirm, for I observed that it requires large doses of cobra poison (6–15 mg.) to kill a rabbit, if the poison be administered per rectum, in the form of an enema. Under such conditions, no doubt, the greater part of the poison would be taken up by the portal radicles.

Of more interest are, however, the following observations. A concentrated extract in physiological saline solution was made of a normal rabbit's liver. Of this, 4 c.c. were mixed with 2 c.c. of a solution of cobra poison, and the resulting mixture (6 c.c.) allowed to stand in a cool place for six hours. Two guinea-pigs were then inoculated with this mixture.

Guinea-pig 1 received subcutaneously 4 c.c. of the mixture (*i.e.*, 1·3 c.c. of the cobra poison solution and 2·6 c.c. of the liver extract). The animal survived for 50 hours, whereas the control animal died in two hours.

Guinea-pig 2. The remaining 2 c.c. (containing ·6 c.c. of the cobra poison solution) were inoculated into this animal subcutaneously, with the result that it survived for over 60 hours. The control animal died in two-and-a-half hours.

A fresh liver extract was made in exactly the same manner, and of this, 4 c.c. were mixed with 2 c.c. of cobra poison solution. After the mixture had been allowed to stand for 24 hours, it was inoculated into a guinea-pig.

Guinea-pig 3, thus injected subcutaneously with the 2 c.c. of cobra poison solution and the 4 c.c. of liver extract, survived for 12 hours. The control animal died in two hours.

The experiment was repeated on a third occasion with the following results:—

Guinea-pig 4 received subcutaneously ·2 mg. of cobra poison +2 c.c. of liver extract; it survived.

Guinea-pigs 5, 6, 7 received subcutaneously respectively ·25 mg., ·4 mg., and ·5 mg. of cobra poison, mixed in each instance with 2 c.c. of liver extract. The animals died respectively after 4¾, 4¼, and 4 hours. Control animals were inoculated with ·2 mg. of cobra poison, and all died in 1 to 1½ hours.

There can be no doubt, then, that in these experiments the liver extract had a marked retarding influence on the action of cobra venom. I may mention that similar action of the liver extract *in vitro* is well known to physiologists, and that Sobernheim† has made experiments with cholera virus similar to those I have made with cobra poison: with this important difference, however, that he used the injection of liver extract as a preventive measure. The continuation of these experiments has been left for a future date. I may, however, mention that on one occasion, working with the liver extract of a young rabbit 3–4 weeks old, I obtained no such antitoxic action.

Notes by Dr. Kanthack on "Immunising Serum."

Notes on Immunising Serum; by Dr. Kanthack.

Some time ago I began some experiments with a view to investigate the specific nature of immunising serum.

Dr. Klein‡ had shown that by injecting suspensions of agar-agar cultures of one micro-organism into the peritoneal cavity of a guinea-pig it is possible to immunise that animal against a similar injection

* Journal of Physiol., loc. cit. † Zeitschrift f. Hygiene, vol. xx., 1895, p. 454

‡ Twenty-second Annual Report of the Local Government Board, 1892–93, Report of the Medical Officer, pp. 380–4.

of another organism. Thus, he had demonstrated in regard of a number of organisms, viz.: B. prodigiosus, B. subtilis, B. typhosus, V. Finkler-Prior and V. Choleræ Asiaticæ, that by intraperitoneal injection of one form immunity may be produced against any and all of the others. His observations have been confirmed by myself, in conjunction with Dr. F. F. Wesbrook,* and since, on a more extensive scale, by Sobernheim† and others. Voges‡ has given an exhaustive résumé of the literature referring to this matter in the Centralblatt für Bakteriologie. The importance of Dr. Klein's experiments has been acknowledged on all sides; indeed they appeared at first to shake the foundations of our belief in the specificity of immunity, according to which, by means of administration of a given organism or its products, we can immunise *only* against infection with that organism or against intoxication with its products.

Local Immunity.—It might be objected that Dr. Klein in his experiments was dealing with so-called local immunity of the peritoneal cavity. As a matter of fact, this objection has been made. It is, however, not a valid one, at least not in the cases, and with the micro-organisms, studied by me. Those that I used were B. prodigiosus, B. pyocyaneus, and V. Choleræ Asiaticæ. And I found that on inoculating gradually increasing doses of a B. prodigiosus suspension into the peritoneal cavity, the animal acquired an immunity alike against intraperitoneal injection of the B. pyocyaneus suspension and subcutaneous injection of a broth culture of the B. pyocyaneus. That the effect produced by Dr. Klein does not depend on local immunity has also been shown by Dr. Wesbrook,§ who, avoiding intraperitoneal injections, produced general immunity, including peritoneal immunity, by means of inoculating the bacterial products into the thigh.

I quote three experiments to demonstrate this point:—

Experiment i.

March 28, 1895. Rabbit inoculated intraperitoneally with a small quantity of a suspension of an agar-agar culture of *B. prodigiosus.*

April 1. A further small intraperitoneal injection of this culture was given.

April 6. A whole culture was similarly administered.

April 16. One-fifth of an agar-agar culture of *B. pyocyaneus* was given intraperitoneally.

May 15. Animal was alive and well. The control animal had died in less than 24 hours.

Experiments ii. and iii.

March 28, 1895. Two other rabbits were prepared in the same manner.

April 16. One rabbit received a B. pyocyaneus suspension (one fifth of a culture) subcutaneously; the other 1 c.c. of a broth culture of the microbe subcutaneously

May 16. Both animals were alive and well. Whereas both control animals had died in 24 hours.

"Local immunity" will not, therefore, explain the results obtained with these micro-organisms.

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* British Medical Journal, 1893, pp. 572–75.
† Hygienische Rundschau, 1893, No. 22.
‡ Centralbl. f. Bakt. u. Par. 1896, vol. xix., p. 293, &c.
§ Hygienische Rundschau, 1894, No. 18.

Duration of Vicarious Immunity.—I have made no exhaustive experiments to estimate the duration of immunity produced by *vicarious* inoculation. According to Pfeiffer and Issaeff* the vicarious immunity of the peritoneal cavity produced in this manner is of short duration; *i.e.*, the immunity established against the B. pyocyaneus by means of B. prodigiosus would, according to them, disappear in about 14 days: on the other hand, the immunity against the B. prodigiosus produced by means of B. prodigiosus itself would be a more lasting property. Pfeiffer and Issaeff did not actually work with these organisms, but they propound as a general law that a specific immunity lasts for a long time, whereas a vicarious immunity is but passing. Their own experiments certainly favour such a view. As regards my own observations, the vicarious immunity lasted often at least 14 days, and in Dr. Klein's cases often much longer. Sobernheim† and Wesbrook‡ closely agree with Pfeiffer and Issaeff; and I think we must allow that this difference between the duration of specific and that of vicarious immunity does exist, and that the former is the more lasting. It is well known that a temporary immunity may be produced in rabbits against anthrax by means of inoculating these animals with other organisms, such as the B. pyocyaneus and the Streptococcus erysipelatos; and that in many cases an immunity may be brought about by concurrent inoculations of two different organisms, or by inoculation of an organism along with a chemical or bacterial poison.§ Yet in most cases immunity is sought to be produced by inoculations with the particular organism against which we wish to protect the animal.

The idea of specificity in immunity is so firmly rooted, that after the surprising revelations of Dr. Klein, the question naturally arose as to how the serum of the immunised animals reacts. Is the immunising serum specific in its action; that is, does the serum of an animal protected by intraperitoneal injections of B. prodigiosus suspensions immunise *only* against the B. prodigiosus or does it immunise also against other organisms, *e.g.*, the B. pyocyaneus?

Action of Serum of Immunised Animals.—According to Behring the serum of immunised animals is strictly specific in its action, and this is still believed by most observers. There exists, however, a section of observers who are disinclined to believe in the specificity of action of immunising serum, and some observers reject it altogether. As far back as 1893, in conjunction with Dr. Wesbrook, I‖ demonstrated that the serum of an animal *specially* immunised (in whatever way) against cholera can alone confer a true immunity against large doses of the vibrio of that disease; and further, that although, by means of intraperitoneal injections of a guinea-pig with B. prodigiosus suspensions, we can immunise it against intraperitoneal injections with several times the lethal doses of B. pyocyaneus suspensions, the serum from a guinea-pig immunised against the former microbe has no action in protecting against equal doses of the latter. It is well known that observations to this effect have been since more fully elaborated by Pfeiffer, and that the "serum test" is based on such observations.

During the last 12 months I have again made numerous experiments with B. prodigiosus, B. pyocyaneus, V. Choleræ Asiaticæ, and I am in a

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* Zeitschrift f. Hygiene, vol. xviii.

† Ibidem, vol. xx., p. 441-6. ‡ Loc. cit. (Hyg. Rundschau).

§ Annual Reports of Local Government Board, Report of Medical Officer, vol. xxi., p. 185; vol. xix., p. 215.

‖ Loc. cit.

App. B. No. 4. Notes on Immunising Serum; by Dr. Kanthack.

position to maintain that a "Prodigiosus serum" has no power of preventing an infection with B. pyocyaneus or with V. choleræ. In fact, that each serum, viz., prodigiosus serum, pyocyaneus serum, and cholera serum, is specific in its action, the prodigiosus serum counteracting only an infection with B. prodigiosus, the pyocyaneus serum only an infection with B. pyocyaneus, the cholera serum only an infection with V. choleræ; and this notwithstanding that by means of direct inoculations of any one of these organisms or of its products we can produce a vicarious immunity, of some duration, against infection with either of the other two. In these experiments we must, however, work with more than just the lethal dose or low multiples of the lethal dose, for Issaeff* has shown that by means of subcutaneous or intraperitoneal injections of normal serum a slight and transient immunity can be produced againt small doses of the cholera vibrio.

I append a few experiments which make this point clear :—

(A.) A guinea-pig was first injected intraperitoneally with one-eighth of a tube of Haffkine's attenuated vaccine of V. choleræ, and a week later with one-eighth of a tube of his strong vaccine. Six days after this second inoculation its blood was collected, and the serum separated by means of the centrifugal machine.

April 21, 1895. Four guinea-pigs (*A. B. C. D.*) were injected intraperitoneally with 1 c.c. of this serum, and were subsequently dealt with in the following manner :—

(1.) *Guinea-pig A.* :—
April 25, 1895. One-third of a tube of Haffkine cholera strong virus was injected intraperitoneally. The animal remained alive and well, whereas the control animal died in about 24 hours.

(2.) *Guinea-pig B.* :—
April 25, 1895. Half a tube of a broth culture of V. choleræ was injected intraperitoneally. The animal remained alive and well, whereas the control animal died next day.

(3.) *Guinea-pig C.* :—
April 25, 1895. Half a tube of B. prodigiosus suspension was injected intraperitoneally. The animal died next day. Control animal also died next day.

(4.) *Guinea-pig D.* :—
April 25, 1895. One-fifth of a tube of B. pyocyaneus suspension was injected intraperitoneally. The animal died next day. Control animal also died next day.

(B.) A guinea-pig was immunised by means of subcutaneous inoculations with broth cultures of V. choleræ sterilised by heating at 70° C. for two hours.

The immunisation was practised as follows :—

April 1, 1895. 4 c.c. of sterilised broth culture of this vibrio (1·5 c.c. of this culture before sterilisation killed an animal in 18 hours).
April 3, 1895. 1 c.c. of similar sterilised broth culture.
April 6, 1895. 4 c.c. " " " "
April 11, 1895. 4 c.c. " " " "
April 15, 1895. 4 c.c. " " " "
April 22, 1895. The animal was killed, its serum separated, and four guinea-pigs (*a. b. c. d.*) treated therewith—

* Zeitschr. f. Hyg., vol. xvi., pp. 287–328.

(1.) *Guinea-pig a.:—*

April 22, 1895. 2 c.c. of the serum were injected intraperitoneally.

April 27, 1895. Half a tube of V. choleræ suspension was injected intraperitoneally. The animal remained alive and well. Control animal died next day.

(2.) *Guinea-pig b.:—*

April 22, 1895. 2 c.c. of the serum were injected intraperitoneally.

April 27, 1895. The animal was injected intraperitoneally with one-half of a broth culture of V. choleræ. It remained alive and well. Control animal died next day.

(3.) *Guinea-pig c.:—*

April 22, 1895. 2 c.c. of the serum were injected intraperitoneally.

April 27, 1895. Half a tube of B. prodigiosus suspension was injected intraperitoneally.

April 28, 1895. Animal dead. Control animal died at about the same time.

(4.) *Guinea-pig d.:—*

April 22, 1895. 2 c.c. of the serum were injected intraperitoneally.

April 27, 1895. One-fifth of a tube of B. pyocyaneus suspension was injected intraperitoneally.

April 28, 1895. Animal dead. Control animal died at about the same time.

(c.) A student in the laboratory whose normal serum had no immunising power in doses of 1·5 c.c., was treated by means of Haffkine's method of anti-cholera vaccination, as follows:—

April 6, 1895. One-eighth of a tube of Haffkine's attenuated vaccine was injected into the arm.

April 18, 1895. One-eighth of a tube of Haffkine's strong vaccine was injected in the same situation.

April 25, 1895. Some blood was removed by means of a phlebotomy, and with the serum separated four guinea-pigs were treated as follows:—

(1.) *Guinea-pig i.:—*

April 25, 1895. 1·5 c.c. of the serum were injected intraperitoneally.

May 2, 1895. One-half of a tube of V. choleræ suspension was injected intraperitoneally; and a like amount into a control animal.

May 3, 1895. Control animal dead. The other animal remained alive.

(2.) *Guinea-pig ii.:—*

April 25, 1895. ·25 c.c. of the serum was inoculated subcutaneously.

May 2, 1895. One-third of a virulent broth culture of V. cholera was injected intraperitoneally; and a like amount into a control animal.

May 4, 1895. Control animal dead. The other animal remained alive.

(3.) *Guinea-pig iii.:—*

April 25, 1895. 1·5 c.c. of the serum were injected subcutaneously, and 1·5 c.c. intraperitoneally.

May 2, 1885. One-half of a tube of B. prodigiosus suspension was injected intraperitoneally, and a like amount into a control animal. Both guinea-pigs were dead next morning.

(4.) *Guinea-pig iv.*:—

April 25, 1895. 1·5 c.c. of the serum were injected subcutaneously, and 2·5 c.c. intraperitoneally.

May 2, 1895. One-fifth of a tube of B. pyocyaneus suspension was injected intraperitoneally, and a like amount into a control animal. Both animals were dead next morning.

(D.) I administered to myself the cholera vibrio in the following manner:—

June 1, 1895. 3 c.c. of a sterilised broth culture of V. choleræ Asiaticæ *per os*.

June 3, 1895. ·4 c.c. of a living broth culture 8 days old *per os*.
June 4, 1895. 6 c.c. of a sterilised broth culture *per os*.
June 5, 1895. 8 c.c. of a sterilised culture *per os*.
June 6, 1895. 1 c.c. of a living broth culture *per os*.
June 7, 1895. 10 c.c. of a sterilised culture *per os*.
June 8, 1895. 10 c.c. of a sterilised culture *per os*.
June 9, 1885. 10 c.c. of a sterilised culture and 3 c.c. of a living culture *per os*.

On every occasion of swallowing the microbe a solution of sodium carbonate was used to neutralise the gastric acidity.

June 16, 1895. Some blood was obtained from my arm by means of a phlebotomy, and, the serum having been separated, 3 c.c. of the latter were injected into each of three guinea-pigs intraperitoneally. Subsequently these guinea-pigs were treated as follows:—

June 20, 1895. *Guinea-pig α*. One-third of a tube of V. choleræ suspension was injected intraperitoneally.

Guinea-pig β. One-half of a tube of B. prodigiosus suspension was injected intraperitoneally.

Guinea-pig γ. One-fifth of a tube of B. pyocyaneus suspension was injected intraperitoneally.

Three control animals were inoculated with similar quantities of the above organisms. The result was that guinea-pig α alone remained alive; all others died next morning.

The above several series of experiments show that, as far as the three organisms which were used are concerned, the serum obtained from an animal immunised against one of them has a true preventive action on that one only, not on any other. Also they show that as far as this power of the serum is concerned, it is quite immaterial what method of immunisation is used, *i.e.*, whether intraperitoneal injection, subcutaneous injection, or administration *per os*; and quite immaterial too whether as immunising substance agar-agar cultures, broth cultures, or the sterilised products of broth cultures be administered. Again, it matters not whether the immunising serum be injected into the peritoneal cavity or into the subcutaneous tissue of the experimental animal, nor whether this animal be finally tested by intraperitoneal or by subcutaneous injection.

App. B. No. 4.

Notes on Immunising Serum; by Dr. Kanthack.

In this connexion, I may remark that previous observations have forced upon me the conviction that, so far as these three organisms are concerned, an immunity produced by an intraperitoneal injection of an agar-agar culture suspension carries with it immunity from the effects of an intraperitoneal injection of broth or of gelatine cultures, and also an immunity from the effects of subcutaneous injections of broth or gelatine cultures. I do not, of course, assert that these matters apply to all micro-organisms in general; in fact, we have reason to believe, from Dr. Klein's observations, that they do not. I am restricting my inferences to observations made with these three organisms, as to which the facts indicate certainly the specificity of the serum of the immunised animal; a belief which is firmly entertained by Sobernheim and others.

I have made some experiments with the serum of animals immunised by means of injection of living bacteria, for the purpose of ascertaining whether it exerts a germicidal influence of a specific sort against the particular living microbe wherewith the animal furnishing the serum had been immunised.

Experiments with the Serum of Animals protected against Cholera Infection.

Two guinea-pigs (A. and B.) were injected with repeated small doses of a suspension of a 24-hours-old agar-agar culture of cholera vibrios prepared as follows:—About 5 c.c. of broth were added to a fresh agar-agar culture, and then the growth was scraped off; of the resulting suspension ·1–·2 c.c. were injected every two hours into the peritoneal cavity of each guinea-pig.

March 10, 1896. These two guinea-pigs had each four such injections.

March 11, 1896. They were allowed to rest.

March 12, 1896. They each had again four minimal injections.

March 17. Blood was obtained from one of these guinea-pigs (A.), and the serum separated.

To test the power of this serum, I took three guinea-pigs, (*a*), (*b*), (*c*).

(1.) *Guinea-pig* (*a*). One-quarter of an agar-agar culture of V. choleræ + 1 c.c. of serum were injected intraperitoneally.

(2.) *Guinea-pig* (*b*). One-half of an agar-agar culture of V. choleræ + 1 c.c. of serum were injected intraperitoneally.

(3.) *Guinea-pig* (*c*). One-quarter of an agar-agar culture of V. choleræ alone, without serum, was injected intraperitoneally.

Result.—Guinea-pig (*a*) survived; the other two died, and the vibrios were readily recovered from their peritoneal cavities.

Guinea-pig B., which had also been previously prepared with multiple inoculations, was tested on March 19, *i.e.*, seven days after the last inoculation, with one-half of an agar-agar culture of cholera vibrios. It remained alive, although the control animal died in less than 24 hours.

It is extraordinary how potent the guinea-pig serum becomes after a few intraperitoneal injections of this animal with minimal doses of living cultures of the cholera vibrio. Thus, of the serum of guinea-pig A., 1·5 c.c. were injected intraperitoneally into a guinea-pig, and a day later one-half of an agar-agar culture of V. choleræ was similarly injected. As a result, the animal remained alive, while the control animal died.

Having convinced myself of the power of this serum, I next proceeded to ascertain whether it had any influence over the B. typhosus. Four guinea-pigs were employed (α, β, γ, δ).

(1.) *Guinea-pig α.* 1·5 c.c. of the serum + one-quarter of an agar-agar culture of cholera vibrios were injected intraperitoneally.

(2.) *Guinea-pig β.* 1·5 cc. of the serum + one-quarter of an agar-agar culture of B. typhosus were injected intraperitoneally.

(3.) Guinea-pig γ. One-quarter of an agar-agar culture of cholera vibrios was similarly injected without serum.

(4.) Guinea-pig δ. One-quarter of an agar-agar culture of B. typhosus was injected intraperitoneally without serum.

Result.—All animals except guinea-pig α died.

The same results were obtained on repeating the experiments.

During the course of these observations I have noticed several times that though animals bore a concurrent injection of serum and of vibrios, a real immunity had not necessarily been established. An experiment will make my meaning clearer.

March 18, 1896. A guinea-pig was inoculated intraperitoneally with 1·5 c.c. of the cholera serum from guinea-pig A, mixed with one-quarter of an agar-agar culture of the cholera vibrio. The animal survived.

March 23, 1896. I gave the same animal one-quarter of an agar-agar culture of the vibrio without serum.

March 24, 1896. It died, and its peritoneal cavity was full of cholera vibrios.

It would appear that in this case the serum had expended its total energy in enabling the tissues to counteract the concurrent injection of one-quarter of an agar-agar culture of the vibrio.

On the other hand, if I injected the serum first (1·5 c.c.), and next day inoculated an experimental animal intraperitoneally with even one-half of an agar-agar culture of the cholera vibrio, it resisted the subsequent injection successfully. I am not prepared as yet to discuss this point more fully; the number of my observations are too limited.

These experiments, however, at any rate show that the serum of an animal protected against cholera has no immunising value with regard to typhoid infection.

Experiments with the Serum of Animals protected against Typhoid Infection.

Method of Immunisation: To obtain a condition of immunity as rapidly as possible, I employed the method already described, namely, of repeated intraperitoneal injection of rabbits with minute doses of living typhoid bacilli. Cultures of the microbe on agar-agar, 24 hours old, were used. To each such culture tube, 5 c.c. of broth were added, and a suspension prepared by scraping the growth off the surface of the medium. Of this suspension ·2 c.c. was injected four times daily during the course of eight hours. It is almost astonishing how quickly, estimating the degree of immunity by the preventive action of the serum, a marked immunity can be conferred upon the animal in this way.

Feb. 27, 1896. Two rabbits (R. 5 and R. 6) were subjected to repeated intraperitoneal injection of minute doses (·2 c.c.) of the above-mentioned suspension of typhoid bacilli. Four injections were given.

Feb. 28 and Feb. 29, 1896. The same treatment was repeated each day, so that altogether the animals had each 12 injections of minute doses, or 2·4 c.c. of the suspension altogether, *i.e.*, less than half a culture.

March 4, 1896. R. 5 was bled, and by means of the centrifugal machine 5 c.c. of its serum were obtained.

This serum was tested on three large guinea-pigs as follows:—

(*a*.) *Guinea-pig I.* Intraperitoneal injection of 1 c.c. of serum + one-half of a culture of typhoid bacilli (agar-agar). It died after six days.

(*b*.) *Guinea-pig II.* Intraperitoneal injection of 1 c.c. of serum + one-quarter of a culture of typhoid bacilli (agar-agar). This animal was ill for some days, but recovered after six days.

(*c*.) *Guinea-pig III.* Intraperitoneal injection of one-quarter of a culture of typhoid bacilli (agar-agar) alone, without serum. It died after 16–18 hours.

These three experiments suffice to demonstrate the efficacy of this rapid method of immunisation.

March 4, 1896. Another guinea-pig (IV.) was injected with 1 c.c. of the serum alone.

March 7, 1896. Its immunity was tested with one-half of an agar-agar culture of typhoid bacilli. The animal remained perfectly well, so that the preventive value of the serum was certainly surprisingly great.

The immunisation of Rabbits 5 and 6 was continued further—

March 7, 1896. Each received four intraperitoneal injections of small quantities of agar-agar culture of typhoid bacilli.

March 9, 1896. The same process was repeated.

March 11, 1896. " " "

March 17, 1896. Rabbit 6 was bled, and serum separated from its blood.

This serum was tested on three large guinea-pigs in the same manner as above.

(1.) *Guinea-pig α.* 1 c.c. of serum + one-half of a typhoid culture. Remained alive and well.

(2.) *Guinea-pig β.* 1 c.c. of serum + one-quarter of a typhoid culture. Remained alive and well.

(3.) *Guinea-pig γ.* One-quarter of a typhoid culture alone, without serum. Died in 24 hours.

The immunising value of the above serum is thus clearly established. I do not hesitate to assert that this is one of the best methods of speedily obtaining a preventive serum for laboratory purposes.

The two rabbits above referred to (R. 5 and R. 6) were subjected to further treatment, subsequent to March 17th, in the following manner:—

March 19, 1896.	Four minute intraperitoneal injections as above.
March 21, 1896.	Repeated.
March 23, 1896.	"
March 28, 1896.	"
April 1, 1896.	"
April 8, 1896.	One-half of a typhoid culture intraperitoneally.
April 15, 1896.	One-half " "
April 23, 1896.	One-half " "
April 28, 1896.	One-half " "

Rabbit 5 was bled on March 25, 1896, and its serum used for further experiments—

(1.) *Guinea-pig A.* received one-quarter of a typhoid culture + 1 c.c. of this serum, intraperitoneally. Survived.

(2.) *Guinea-pig B.* received one-quarter of a typhoid culture, intraperitoneally. Died in 18–24 hours.

(3.) *Guinea-pig C.* received one-sixth of a cholera culture (Berlin) +2 c.c. of the serum. Died in 40 hours.

(4.) *Guinea-pig D.* received one-sixth of a cholera culture (Berlin). Died in 36 hours.

(5.) *Guinea-pig E.* received one-fifth of a pyocyaneus culture + 2 c.c. of the serum. Died in 24 hours.

(6.) *Guinea-pig F.* received one-fifth of a pyocyaneus culture. Died in 24 hours.

(7.) *Guinea-pig G.* received one-quarter of a prodigiosus culture + 2 c.c. of the serum. Died in 48 hours.

(8.) *Guinea-pig H.* received one-quarter of a prodigiosus culture. Died in 48 hours.

This typhoid serum therefore acted as a preventive only in guinea-pig A., *i.e.*, it was specific against adequate doses of the typhoid bacillus *only*. In all the other cases it proved quite useless, thus confirming the previous observations. As far as cholera is concerned, I cannot therefore agree with Sanarelli,* who asserts that he succeeded in protecting guinea-pigs against Koch's vibrio by means of an anti-typhoid serum. It may be objected that my serum was not strong enough; but I must point out that it was capable of neutralising the effects of a rapidly fatal dose of typhoid material, and that I used a large quantity of it in the case of the cholera infection. I have repeated this experiment since on several occasions, and have so far invariably obtained results directly opposed to Sanarelli's. He used a different variety of choleraic vibrio, which may possibly explain the difference in our results; but his observations so far have not been confirmed by others. Accordingly I find no reason to doubt Pfeiffer's view, recently confirmed by Sobernheim,† on the specificity of immunising serum.

A final set of similar experiments was made, when the immunising value of this serum had been further raised. Rabbit 6 was bled on March 31st, 1896, and the power of its serum tested, with the following result:—

(1.) *Guinea-pig* (*a*) received intraperitoneally one-quarter of a typhoid culture + ·5 c.c. of the serum. This animal remained alive.

(2.) *Guinea-pig* (*b*) similarly received one-half of a typhoid culture + ·5 c.c. of the serum. Dead next day.

(3.) *Guinea-pig* (*c*) similarly received one-quarter of a typhoid culture, without serum. Dead next day.

In order to test the behaviour of this serum, towards B. coli communis, four guinea-pigs were used:—

(1.) *Guinea-pig A.* received 1 c.c. of the serum + one-half of a typhoid culture. The animal remained alive.

* Annales de l'Inst. Pasteur, 1895, No. 3.

† Zeitschr. f. Hygiene, xx., pp. 446–52.

(2.) *Guinea-pig B.* received one-quarter of a typhoid culture, without serum. Died in 48 hours.

(3.) *Guinea-pig C.* received 1 c.c. of the serum + one-half of a culture of B. coli. Died in three days.

(4.) *Guinea-pig D.* received one-half of a culture of B. coli., without serum. Died in four days.

This constitutes an additional proof of the specificity *in corpore* of this immunising serum. The number of experiments performed so far is no doubt small; but they are sufficient to show that the serum of an immunised animal displays its preventive activity to a marked degree *solely* against the particular microbe with which the animal furnishing the serum has been inoculated. I do not as yet venture to assert that a preventive effect can only be ensured by means of a serum obtained in the above way. There are observations in our possession, especially those of Pfeiffer and Issaeff, above alluded to, which show that occasionally the serum of normal animals may prevent an infection. But such phenomena are decidedly the exception and success can be obtained only while working with small doses, and even then the immunity is of short duration. For the present it must be considered to be the rule, that to prevent an infection it is necessary to employ a serum prepared by an immunisation specific in the sense I have indicated. The majority of observers agree as to this, and, indeed, these experiments of mine only form a small fragment of the large mass of evidence to this effect which has been adduced from various laboratories during the last year or two. The question is, however, by no means settled yet; a consensus of opinion has not so far been obtained. Thus Hüppe* strongly attacks the idea of specificity, founding his views chiefly on recent observations on normal serum and on immunity from snake poison.

Pfeiffer's, Bordet's, and Durham's Tests.

Pfeiffer, as already mentioned, is so firmly convinced of the true specificity of the serum obtained from immunised animals, that he uses such serum as a test whereby to identify the vibrio of cholera and the bacillus of typhoid fever. His original method, in respect to the cholera vibrio, consisted in inoculating guinea-pigs with a mixture of "cholera serum" and of the culture of the vibrio to be tested: if in such case the animal survives, the vibrio must be, he says, true cholera vibrio. It is not for me to impugn the soundness of his contention quâ *positive* result of his test in the above sense. I have no personal experiences to record; moreover, others are devoting their special attention to this matter, and there are already a considerable number of observations in existence, some agreeing with Pfeiffer, others disagreeing. All I would say is, that I accept and endorse the criticisms of Bordet.† This observer writes thus: "if we were dealing with a vibrio obtained from "a true case of cholera, possessing all the morphological and biological "characters of Koch's vibrio, failing only in Pfeiffer's test (or any of its "modifications), we have at present, at any rate, no right to assert "that the disease was not cholera, and that the particular vibrio had "nothing in common with the specific vibrio." All *negative* results must, in my opinion be accepted with cautious reserve.

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* Naturwissenschaftliche Einführung in die Bacteriologie. Wiesbaden, 1895, p. 215–26.

† Annales de l'Inst. Pasteur, June, 1895, p. 494.

Pfeiffer observed, during his researches comprising injection of cholera vibrios into the peritoneal cavity of highly immunised guinea-pigs, that the vibrios underwent curious changes: (*a*), they became immobile; and (*b*), finally granular. The same changes are observed on injecting a mixture of cholera serum and cholera vibrios into a normal guinea-pig; and they occur even after the serum has been heated to 60° or 70° C., whereby it is deprived of its natural bactericidal power—of its alexins, to use Buchner and Hankin's phraseology. These changes Pfeiffer declares are brought about without the direct intervention of the leucocytes of the experimental animal. The appearances described by Pfeiffer are generally called "Pfeiffer's phenomenon." Metchnikoff* showed that this phenomenon may be observed *in vitro* on mixing cholera vibrios with "cholera" serum and then adding some leucocytes obtained from the peritoneal cavity of a guinea-pig. Bordet further showed that, instead of peritoneal leucocytes, it is sufficient to add to the mixture of vibrios and preventive serum *in vitro* defibrinated blood or the fresh serum of a normal animal. This granular transformation of the cholera microbes, Bordet states, is characteristic of Koch's vibrio under such conditions, and his modification of Pfeiffer's test has the advantage of not requiring animals; it can be observed in watch glasses and in test tubes, or even on the microscopic slide. Bordet's original method consisted in mixing together on a slide small quantities of suspension of cholera vibrios, of preventive serum, and of normal serum, and then watching under a microscope the granular metamorphosis of the vibrios. He found that wherever Pfeiffer's phenomenon could be observed, there his reaction (*i.e.* the granular metamorphosis) also was positive, and *vice versâ*. The French procedure is, therefore, merely a modification of the German method. Bordet† writes that "if one uses "the serum of a vaccinated (immunised) guinea-pig, it is not necessary "to add the normal serum to bring about a positive result." His words are: "le sérum de cobaye vacciné bien frais provoque à lui seul une "transformation parfaite: il n'est aucunement nécessaire de l'additionner "de sérum neuf." He further mentions that the serum of immunised guinea-pigs, kept for some weeks, when mixed with suspensions of cholera vibrios without the addition of normal serum, produces (1) an immobilisation, and (2) an agglomeration of these vibrios ("ces vibrions "se réunissent en amas flottants dans le liquide"); and this effect is not destroyed on heating the serum to 50–55° C.

Recently Mr. H. E. Durham‡ communicated another method associated with his and Gruber's names, which consists in adding minute quantities of *potent* preventive serum to emulsions of actively mobile microbes. If the result is positive, there is an almost immediate aggregation of the bacteria into clumps (Bordet's "réunion en amas"), followed by loss of mobility and marked inhibition of growth. A complete reaction is obtained when all the clumps settle down, leaving a perfectly clear fluid. The writer, however, states that in the case of cholera "the action of cholera serum upon more or less closely related "vibrios may be complete or nil. A series of gradations in intensity "of reaction has been observed with cholera serum and vibrios, and vice "versâ. The action of such serum cannot therefore be regarded 'as "specific,' and the limits of the absolute value of such serum tests for "the diagnosis of cholera vibrios has yet to be determined."

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* Annales de l' Inst. Pasteur. 1895, vol ix., No. 6, p. 489 *et seq.*
† Ibidem, p. 496.
‡ Proceedings of Royal Soc., January 23, 1896.

A number of observations have been made by me in this subject-matter, and from these I have come to the conclusion that the test as described by Durham, although very valuable, is indeed not absolutely specific. The serum that I used was obtained, in each instance, from highly immunised animals. For each experiment a suspension of fresh agar-agar cultures was made in 5–10 c.c. of broth, and 4 per cent. of the particular serum added. Here are some of my experiments.

I. *Typhoid Serum* (Rabbit) :—

(*a.*)	Bacillus of typhoid fever i.	= +	The typhoid organisms had been separated from eight fatal cases of enteric fever.
(*b.*)	" " ii.	= +	
(*c.*)	" " iii.	= +	
(*d.*)	" " iv.	= +	
(*e.*)	" " v.	= +	
(*f.*)	" " vi.	= +	
(*g.*)	" " vii.	= +	
(*h.*)	" " viii.	= +	
(*i.*)	Bacillus coli communis 2 -	= −	

In this series of tests the action of the serum was truly specific; all the various typhoid bacilli obtained from diverse sources reacting positively, the bacillus coli communis alone reacting negatively.

II. *Typhoid Serum* (Rabbit) :—

(*a.*)	Bacillus of typhoid fever i.	= +	See above.
(*b.*)	" " iii.	= +	
(*c.*)	" " vi.	= +	
(*d.*)	" " viii.	= +	
(*e.*)	Vibrio of cholera - -	= −	
(*f.*)	Bacillus coli communis 2 -	= −	
(*g.*)	Glasgow typhoid bac.* -	= −	(Obtained from Glasgow.)
(*h.*)	B. pyocyaneus - -	= −	
(*i.*)	B. prodigiosus - -	= −	

Here again the action of the serum is truly specific; the negative reaction in (*g.*) may be set aside, since the "Glasgow typhoid bacillus" did not prove to be the true typhoid bacillus.

III. *Typhoid Serum* (Rabbit) :—

(*a.*)	Bacillus coli communis 2	= −	These colon bacilli were obtained from diverse sources.
(*b.*)	" " 3	= −	
(*c.*)	" " 4	= +	
(*d.*)	" " 5	= −	
(*e.*)	" " 6	= −	
(*f.*)	" " 7	= −	
(*g.*)	Vibrio of cholera - -	= −	
(*h.*)	B. prodigiosus - -	= −	
(*i.*)	B. pyocyaneus - -	= −	
(*k.*)	Bacillus of typhoid fever v.	= +	See above.
(*l.*)	" " " viii.	= + +	

In this case a positive result was obtained with typhoid serum and with a true bacterium coli (gas formation, coagulation of milk, flagella, &c.). In the case of B. typhosus viii. the reaction was more marked than with v., the particular sample of microbe with which the animal had actually been immunised.

* This bacillus on staining for flagella proved to be a bacillus coli communis; it forms gas and slowly coagulates milk.

IV. *Coli Serum* (Rabbit) :—

(*a.*) Bacillus coli communis 2 = —		See above.
(*b.*) " " 3 = + (less marked than B. coli communis 4).		
(*c.*) " " 4 = +		
(*d.*) " " 5 = —		
(*e.*) " " 6 = not quite negative.		

(*f.*) " " 7 = +
(*g.*) Vibrio of cholera - - = —
(*h.*) B. prodigiosus - - = —
(*i.*) B. pyocyaneus - - = —
(*k.*) Bacillus of typhoid fever v. = not quite negative.
(*l.*) " " " viii. = " "

Although this animal had been strongly immunised against the B. coli, the reaction was unsatisfactory; the same observation has been made by Durham and no doubt depends on the fact that the "bacterium coli" includes different varieties and species of organisms. However, on adding normal serum as well, as recommended by Bordet, a positive reaction was often at once obtained.

The two typhoid organisms did not react absolutely negatively with coli serum.

V. *Pyocyaneus Serum* (Rabbit) :—
(*a.*) B. pyocyaneus - - = +
(*b.*) Vibrio of cholera - - = —
(*c.*) Bacillus coli communis 2 - = —
(*d.*) B. of typhoid fever - = —
(*e.*) B. fluorescens - - = —

In this case again the reaction was truly specific.

VI. *Cholera Serum* (Guinea-pig) :—
(*a.*) Vibrio of cholera - - = + +
(*b.*) Bac. of typhoid fever - = not quite negative.
(*c.*) Bac. coli communis - - = —

VII. *Diphtheria Serum* (Klein) (Guinea-pig) :—
(*a.*) B. prodigiosus - - - = —
(*b.*) B. pyocyaneus - - = —
(*c.*) B. coli communis 2 - - = —
(*d.*) B. diphtheriæ (Richmond) - = + } Obtained from diverse sources.
(*e.*) " (Pryce) - - = +
(*f.*) " (Moore) - = +

Dr. Klein's serum was obtained from a guinea-pig which had been thoroughly immunised by means of repeated intraperitoneal inoculations with gelatine cultures of the diphtheria bacillus. The B. diphtheriæ is an immobile organism, and has a marked tendency, even in water or broth, to gravitate to the bottom of the test tube, leaving the supernatant fluid clear. It does not, therefore, form a good test object.

VIII. *Diphtheria* (*Antitoxic*) *Serum* (Horse) :—

		Now added a little fresh ascitic fluid
(*a.*) B. prodigiosus	= —	= —
(*b.*) B. of typhoid fever	= partially +	= +
(*c.*) B. coli communis 2	= " +	= +
(*d.*) Vibrio of cholera	= +	= +
(*e.*) B. pyocyaneus	= +	= +
(*f.*) Vibrio metchnicovi	= —	

(g.) Streptococcus pyogenes - - = —
(h.) Bac. of tetanus - = —

After reading Bordet's more recent paper,* I have no doubt that the above positive reactions are due to the horse's serum, independently of its anti-diphtheritic property, and it must also be remembered that a large quantity of serum was used.

The addition of a little ascitic fluid caused striking changes in (b.) and (c.).

IX. *Fresh Ascitic Fluid:—*

(a.) Vibrio metchnicovi - = —
(b.) „ of cholera - = partially + on adding an excess.
(c.) B. of typhoid fever - = —
(d.) B. coli communis 2 - = —
(e.) B. pyocyaneus - - = —

X. *Ascitic Fluid containing ·5 per cent. Carbolic Acid:—*

(a.) B. prodigiosus	= —	Then added fresh non-carbolised ascitic fluid.	= —
(b.) B. pyocyaneus	= —		= —
(c.) B. of typhoid fever	= —		= —
(d.) B. coli communis	= —		= —
(e.) Vibrio of cholera	= —		= —

XI. *Ascitic Fluid containing 2 per cent. KOH:—*

(a.) B. of typhoid fever = —
(b.) Vibrio of cholera = —

XII. *Human Serum* (obtained from my own blood):—

(a.) B. pyocyaneus - - = —
(b.) Vibrio metchnicovi - = —
(c.) „ „ of cholera = —
(d.) B. coli communis 2 - - = —
(e.) B. of typhoid fever - - = +
(f.) B. fluorescens - - = —

I must remark that in autumn 1894 I had an attack of typhoid fever, which accounts for the above positive reaction with the bacillus of typhoid fever.†

XIII. *Pyocyaneus Serum* (Rabbit) *and Human Serum:—*

(a.) B. pyocyaneus = +	Then heated up both tubes for ½ hour at 60°.	The reaction disappeared.	Added a little of my serum = +.
(b.) B. pyocyaneus = +			Left alone for purposes of control = —.

This experiment shows that, as Bordet* pointed out, heat destroys the reaction, but that the latter is restored on adding a little normal serum, although this normal serum alone has no action on the emulsion of the B. pyocyaneus.

XIV. *Pyocyaneus Serum* (Rabbit).‡

(a.) ·5 c.c. of serum + 2 c.c. of broth + ·1 c.c. of pyocyaneus suspension; incubated at 38° C. Remained clear for some days.

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* Annales de l'Inst. Pasteur, April 1896.—211.

† In this connexion *cf.* A. S. Grünbaum, "Preliminary Note on the Use of the Agglutinative Action of Human Serum for the Diagnosis of Enteric Fever."—*Lancet*, Sept. 19, 1896.

‡ *See also* Charrin et Roger: Société de biologie, 1889, p. 667.

(*b.*) ·5 c.c. of serum + 4 c.c. of broth + ·1 c.c. of pyocyaneus suspension; incubated at 38° C. Remained clear for some days.

(*c.*) ·5 c.c. of serum + 6 c.c. of broth + ·1 c.c. of pyocyaneus suspension; incubated at 38° C. Remained clear for some days.

(*d.*) 3 c.c. of serum + ·1 c.c. of pyocyaneus suspension; incubated at 38° C. No growth, and clear for some days.

(*e.*) 1 c.c. of normal serum + 1 c.c. of broth + ·1 c.c. of pyocyaneus suspension; incubated at 38° C. Very turbid and green next day.

(*f.*) 1 c.c. of normal serum + ·1 c.c. of pyocyaneus suspension; incubated at 38° C. Very turbid and green next day.

Curious results were obtained with anthrax bacilli. The latter do not readily grow in normal rabbit's serum, but I found that occasionally they grew in the serum of a rabbit immunised against B. pyocyaneus. This fact was the more surprising, since there is a natural antagonism inside and outside the animal body between these two organisms.

XV. *Normal Rabbit's Serum.*

(*a.*) 1 c.c. of serum + 2 c.c. of broth freshly inoculated with B. anthracis; incubated at 38° C. Sterile.

(*b.*) 1 c.c. of serum + 3 c.c. of broth inoculated with B. anthracis; incubated at 38° C. Sterile.

(*c.*) 1 c.c. of serum + 4 c.c. of broth inoculated with B. anthracis; incubated at 38° C.. Sterile.

(*d.*) 1 c.c. of serum + 5 c.c. of broth inoculated with B. anthracis; incubated at 38° C. Sterile.

(*e.*) 1 c.c. of pyocyaneus serum + ·1 c.c. of broth inoculated with B. anthracis; incubated at 38° C. Growth after a little delay.

Summary of Observations on Durham's Test.

I cannot, as a result of my observations, pronounce definitely on Durham's test. Its value and its simplicity I do not deny, and I consider that as an aid to diagnosis it is very useful and even necessary; but I do not regard it as possessing absolute certainty, and I gather that Durham himself does not claim this. Its certainty increases with the degree of immunity acquired by the animal, for if this be very high, surprisingly minute quantities of serum may be used for the purpose of producing a conglomeration, so that, as already pointed out by Durham, errors due to the appearance of conglomeration under the influence of normal or heterologous serum can thus be entirely excluded: for so far as our present knowledge goes, it requires comparatively large quantities of normal or heterologous serum to produce Durham's reaction. In the main, I agree with Bordet, to whom I wish to refer once more. He states that the three characteristic points of Pfeiffer's and of his tests are (1) the immobilisation; (2) the conglomeration; and (3) the granular metamorphosis of the micro-organisms. Durham and Gruber, in their modification of Bordet's test, appear to neglect the third point altogether. Bordet shows—and to some extent I have already been able to confirm him—that (*a*) the conglomeration may occur without the action of specific serum, under the influence, for instance, of even normal serum; and this has in part also been shown by Pfeiffer: however it requires

much larger quantities of normal or heterologous serum than of specific serum. Thus "normal horse's serum" gives, according to Bordet, a positive reaction with cholera vibrios, tetanus, typhoid, and colon bacilli, with vibrio metchnicovi, and with streptococci. Bordet shows (*b*) that the action is not always entirely or permanently specific, as the reaction may be lost after passing an organism through the animal body. For a full account of Bordet's objections his original paper should be consulted.

A general conclusion, at this stage, as to the specificity of antitoxic or immunising serum would be premature. The difficulties and contradictions are numerous, but so far the facts tend to support Behring's law, which has been repeatedly alluded to. It is true that Behring's earlier conceptions were too narrow and too limited, for we know now that even a normal serum may possess anti-toxic or bactericidal powers, so as to react positively to Durham's or even Pfeiffer's test. But in such cases its action is but slight and insignificant when compared with that obtained by means of the serum of an immunised animal. The curious power, to react in extremely minute quantities, possessed by the serum of a highly immunised animal, is obviously a freshly acquired property; it is manifested only when tested on the micro-organism against which the animal has been adequately protected. It is necessary, therefore, to carefully distinguish between such *natural* conglomerating, immunising, bactericidal, or antitoxic power as is possessed by normal serum and the *specifically acquired* conglomerating, immunising, bactericidal, or antitoxic quality against a given infection possessed by the serum of an animal which has been immunised against that infection.

No. 5.

REPORT on an INQUIRY into the INFLUENCE of CERTAIN NON-PATHOGENIC MICRO-ORGANISMS, liable to gain ACCESS to FOOD, on the ACTIVITIES of certain other MICROBES that inhabit the HUMAN INTESTINE, and which ordinarily are PATHOGENIC to RODENTS; by Dr. CAUTLEY.

App. B. No. 5.

On the Influence of certain Non-Pathogenic Micro-organisms upon the Activities of Microbes that are Pathogenic; by Dr. Cautley.

Many cases of fatal diarrhœa have been referred in recent years to the action of micro-organisms. In such cases it is probable that the result is due to—

1. The micro-organisms ingested.
2. The chemical products of micro-organisms—
    (*a*) elaborated in the food previous to ingestion;
    (*b*) elaborated in the alimentary canal after ingestion.

In a previous report (Report of the Medical Officer, Local Government Board, 1892–93) on the micro-organisms present normally in the lower ileum of man, I noted that the bacillus coli communis was present in all the cases examined *post mortem*, and frequently in almost pure culture. In a report on the micro-organisms in the mesenteric glands (Report of the Medical Officer, Local Government Reports, 1893–94) I noted that this common and widely distributed microbe was only found on cultural examination in two out of 25 cases. It therefore would seem that if this microbe exerts a pathogenic influence in the body, the effects are brought about by its products developed in the alimentary canal. Many other observers have studied the micro-organisms present in the normal fæces and have isolated various species. Miller (Deutsch. Med. Woch., 1886, p. 781, 1885, p. 843, 1886, p. 117), Brieger (Zeitsch. f. Physiol. Chem., 1884, p. 306), Vignal (Archiv. de Physiol., 1887, p. 492), Koch, Kuisl, Finkler and Prior, Bienstock, Weisser, Stahl, and Escherich (Die Darmbakterien des Saüglings und ihre Beziehungen zur Physiologie der Verdauung," 1886), have isolated and described a large number of varieties in the fæces of adults and infants. Escherich (*loc. cit.*) has further shown that two species are constantly present and largely preponderate in the fæces of milk-fed infants: one, the bacillus lactis aërogenes, occupied the upper portion of the intestinal tract, and the other, the bacillus coli communis, was found in the lower half. As far as is known at present neither of these microbes is capable of setting up diarrhœa. Booker found the bacillus coli communis (Trans. of the Ninth Internat. Med. Congress, vol. iii., 1887, and Trans. Amer Pediat. Soc., vol. i., p. 198, 1889) in almost every case of infantile diarrhœa and cholera infantum examined; but the organism was not especially numerous in the more serious cases, and was found in pure culture in the fæces of a healthy child. A bacillus resembling very closely, if not actually identical with, the bacillus lactis aërogenes of Escherich, was found nearly constantly, and generally predominating, in cases of catarrhal enteritis and cholera infantum; it was present in much greater numbers than in the healthy child. Proteus vulgaris of Hauser was found in a considerable proportion (15 out of 19) of cases of cholera infantum. In the four cases in which this microbe was not found the methods of isolation used were imperfect on account of the hot weather. This organism was not present in the fæces of healthy children, and Booker regards it as the cause of the prominent symptoms of infantile diarrhœa. Jeffries (Trans. Amer. Pediat. Soc., vol. i., 1889, p. 249) examined the fæces of 28 cases of summer diarrhœa in infants; he did

not find the bacillus lactis aërogenes present, and only found varieties of bacillus coli communis which were not fatal to guinea-pigs on inoculation *sub cutem*. 31 different species of microbes were found by him, but no one species constantly.

It is evident that at present neither of the common organisms, bacillus coli communis and proteus vulgaris, can be regarded as by themselves the exciting cause of diarrhœa. Consequently it is of importance to ascertain whether or no, in the presence of and with the aid of some of the common microbes in the food ingested, either of these bacilli can produce a greater or a less general or local effect on the human system. So far very little work has been directed to the elucidation of this problem. Baginsky (Deutch. Med. Woch., 1898, and Zeitsch. f. Physiol. Chem., 1888, bd. xiii. ht. 4) found that the bacillus lactis aërogenes gave rise to acetic acid fermentation of milk sugar, while the bacillus coli communis produced, besides acetic acid, a considerable quantity of lactic and formic acids. He also noted that the former bacillus exerted an unfavourable influence on the growth of a liquefying bacillus (probably proteus vulgaris) which he found constantly in the stools of infants affected with acid diarrhœa, and which was fatal to animals.

Object of the present Inquiry.

To ascertain whether the multiplication or the pathogenic properties of the two widely-distributed bacilli, namely, the bacillus coli communis and the proteus vulgaris, are influenced by association with common non-pathogenic micro-organisms, as, for instance, yeast, oïdium albicans, bacillus lactis, bacillus aceti, and mycoderma aceti.

Methods of Inquiry.

1. By plate culture; to ascertain whether, when admixed, the growth of one organism modified that of the other.
2. By feeding experiments on rodents; to ascertain whether, under similar conditions, diarrhœa or fatal toxæmia ensued.
3. By inoculation experiments on rodents; to ascertain whether, in like circumstances, the local or general effects were modified.

The Biological Characters of the Micro-organisms employed.

Bacillus Coli Communis.—A variety was used which coagulated milk at 20° C. and 37° C. in 24 hours; caused a free development of gas in *gelatin* shake-cultures in 24 hours; grew freely and rapidly on *agar-agar* at 37° C., and freely produced indol in *broth* cultures in four days.

Proteus Vulgaris.—A proteus growing rapidly in broth at 20° C. and 37° C., producing therein dense general turbidity, and exhibiting polymorphous forms and very long chains and threads in 24 hours; causing rapid liquefaction of gelatin in stab and surface cultures; forming a thick, raised, smooth, white growth on the surface of *agar-agar* cultures at 20° C. and 37° C.

Yeast.—A variety forming small, raised, circular, white colonies on *gelatin* plates, and a coherent, smooth, white growth in gelatin surface cultures; rather larger and whiter colonies on the surface of *agar-agar* at 20° C.; moderate turbidity and deposit in *broth* cultures. Growing better at 20° C. than at 37° C.

Oïdium Albicans.—Growing very freely and rapidly on *gelatin* surface cultures, sending out lateral filamentous processes and almost covering the surface of the medium in three days; equally free and extensive growth on *agar-agar* at 20° C.; producing moderate turbidity and deposit in *broth* at 20° C. The organism closely resembles oïdium lactis in morphological and cultural characters, but differs from it in not liquefying gelatin.

Bacillus Lactis.—Forms on the surface of *gelatin* in 24 hours a thin bluish-white opalescent growth; on *gelatin* plates small, raised, smooth, white, circular, or oval colonies, dark brown in colour under a low power of the microscope. In *gelatin* stab-cultures small round colonies develop along the line of inoculation and a scanty raised surface growth round the point of puncture. On *agar-agar* at 20° C. a fairly profuse smooth white growth forms in 24 hours, with moderate white deposit in the condensation fluid. *Broth* at 20° C. becomes slightly turbid in two days, and a scanty stringy deposit slowly settles to the bottom of the test tube. *Milk* at 20° C. and 37° C. undergoes complete coagulation in 24 hours, and has a markedly acid reaction. *Microscopically*, the growth consists of short bacilli with rounded ends and many forms rather like diplococci, often in pairs placed end to end, forming long chains in broth and agar-agar condensation fluid and shorter chains in gelatine cultures; non-motile.

Bacillus Aceti.—Obtained from sour beer; forms a thin, coherent, dirty-grey mycodermatous film on the surface. Isolated colonies on *gelatin* plates develop very slowly; at the end of three days they are small, flat, and dirty-white in colour. On *sugar-gelatin* plates the colonies grow larger and more quickly, sending out ray-like processes. Streak cultures on gelatin exhibit a narrow dirty-white growth along the line of inoculation. On the surface of sugar-gelatin the growth is similar in character but much more profuse. On *agar-agar*, at 20° C., a heaped-up, smooth, white growth forms in three days. *Broth* at 20° C. shows slight turbidity and moderate deposit in three days. The organism is a small, regular, thin, non-motile bacillus. Sterilised light ale inoculated with this bacillus undergoes well-marked acetic acid fermentation in 3–7 days.

Mycoderma Aceti.—Another organism obtained from sour beer; is a regular, ovoid, non-motile bacillus, somewhat like a yeast, forming rosette-like masses in broth cultures. It grows on the usual culture media, but more freely on *sugar-gelatin* than on ordinary gelatin, and more profusely at 20° C. than at 37° C. Isolated colonies on *gelatin* plates are raised, white, and wrinkled on the surface in four days with a lighter peripheral zone. A thick white growth quickly forms on *agar-agar*, and moderate growth and deposit in *broth* cultures. On the surface of light ale it forms a thick, wrinkled, dirty-grey film.

Pathogenic Properties of Bacillus Coli Communis and Proteus Vulgaris.

Bacillus Coli.—Mice are unaffected by subcutaneous inoculation of the microbe. When injected in considerable quantity into the circulation of a guinea-pig it causes death in 24 hours, and the bacillus is found in the blood in great numbers. Small amounts injected into a vein of the rabbit, and larger doses injected subcutaneously or intra-peritoneally into this animal, do not usually produce general infection; if large quantities are injected subcutaneously death ensues after diarrhœa. When a fatal result ensues it is due to toxæmia, and depends on the size of the dose.

App. B. No. 5.

On the Influence of certain Non-Pathogenic Micro-organisms upon the Activities of Microbes that are Pathogenic: by Dr. Cautley.

Proteus Vulgaris.—Is pathogenic for rabbits and guinea-pigs when inoculated subcutaneously, intra-peritoneally, or into the circulation in arge doses. Large doses injected subcutaneously are fatal to mice.

The Inter-action of the above Micro-organisms as illustrated by their growth in Plate Cultures.

The method of making the plate cultures was as follows:—Equal quantities of sterile salt solution were inoculated with traces of each organism from pure cultures, and of the dilutions thus prepared, two in each instance, were then mixed well together. From this mixture gelatin plates were inoculated, except in the case of the bacillus aceti and the mycoderma aceti, for which sugar-gelatin plates were employed. In each experiment the conclusions were drawn from three plates in which the colonies were fairly evenly distributed.

1. Proteus vulgaris and yeast.
2. „ „ „ oïdium albicans.
3. „ „ „ bacillus lactis.
4. „ „ „ bacillus aceti.
5. „ „ „ mycoderma aceti.
6. Bacillus coli „ yeast.
7. „ „ „ oïdium albicans.
8. „ „ „ bacillus lactis.
9. „ „ „ bacillus aceti.
10. „ „ „ mycoderma aceti.

In no experiment did the growth of one organism appear to modify the growth of the other organism present in the same plate.

Feeding Experiments: First Series.

In these experiments mice were the animals employed. To them were administered broth culture, incubated for 3–5 days at 37° C., of proteus vulgaris or of bacillus coli, mixed in each instance with broth culture of one or other of the non-pathogenic organisms kept at 20° C. for a similar period of time. Two mice were used in each experiment, and the dose for each mouse amounted to about 40 c.c. of broth culture of each organism. This mixture was made strongly alkaline by the addition of a few drops of liquor potassæ, and was mixed up with crumbled bread.

1. Proteus vulgaris, together with yeast.
2. „ „ „ „ oïdium albicans.
3. „ „ „ „ bacillus lactis.
4. „ „ „ „ bacillus aceti.
5. „ „ „ „ mycoderma aceti.
6. Bacillus coli „ „ yeast.
7. „ „ „ „ oïdium albicans.
8. „ „ „ „ bacillus lactis.
9. „ „ „ „ bacillus aceti.
10. „ „ „ „ mycoderma aceti.

In no case did diarrhœa or a fatal result ensue, nor did the mice appear in any way affected by the large doses administered.

Feeding Experiments: Second Series.

In this series the mice were fed on the microbes alone, taken in each instance from the surface of solid media. For proteus vulgaris and bacillus coli agar-agar cultures incubated at 37° C. for

3–5 days were used; for yeast and bacillus lactis agar-agar cultures incubated for 3–7 days at 20° C.; for oïdium albicans, gelatin cultures, 3–7 days at 20° C.; for bacillus aceti and mycoderma aceti, sugar-gelatin cultures incubated for 6–7 days at 20° C. For each experiment three cultures of each of two organisms were used, the growth being scraped off the surface and mixed with distilled water or with sterile salt solution. These having been mixed together, were made strongly alkaline, and added to crumbled bread.

1. Proteus vulgaris, together with yeast.
2. " " " " oïdium albicans.
3. " " " " bacillus lactis.
4. " " " " bacillus aceti.
5. " " " " mycoderma aceti.
6. Bacillus coli " " yeast.
7. " " " " oïdium albicans.
8. " " " " bacillus lactis.
9. " " " " bacillus aceti.
10. " " " " mycoderma aceti.

The results in this series were the same as in the previous series where broth cultures were employed. In no single case did the mice appear to be in the least affected by the doses administered.

Inoculation Experiments on Mice: First Series.

The mice were inoculated subcutaneously on the dorsum; two were used in each experiment, half a cubic centimetre of each of two cultures being injected.

1. *Proteus Vulgaris.*—As a control experiment, two mice were inoculated with half a cubic centimetre of a broth culture of proteus which had been incubated for 24 hours at 37° C.

One mouse remained well and did not seem at all affected. The other was found dead at the end of 24 hours. Nothing abnormal was noticed on post-mortem examination. Two cultures on gelatin made from the spleen yielded pure growths of a small coccus. One of two gelatin cultures made from the heart-blood yielded a pure growth of the same coccus; the other a few colonies of proteus vulgaris having the same morphological and biological characters as the organism injected.

2. *Proteus Vulgaris plus Yeast.*—Two mice were inoculated each with similar quantity of the same culture of proteus as was used in the first experiment, *plus* a like quantity of a broth culture of yeast incubated for 14 days at 20° C.

One mouse was ill next day but recovered. The other was dead in 24 hours. Nothing abnormal was found on post-mortem examination. Gelatin cultures inoculated from the heart-blood and from the spleen yielded many colonies of the variety of proteus that was injected.

3. *Proteus Vulgaris plus Oïdium Albicans.*—Two mice were inoculated with the above amount of the same culture of proteus *plus* a like amount of a broth culture of oïdium albicans which had been incubated for 14 days at 20° C.

One mouse was ill next day but recovered. The other was ill next day and died in 48 hours. Nothing abnormal was found on post-mortem examination. Two gelatin cultures made from the spleen and one of two made from the heart-blood yielded pure cultures of the same coccus as was found in the first experiment. The other culture from the blood yielded similiar colonies and several colonies also of the variety of proteus that had been injected.

4. *Proteus Vulgaris plus Bacillus Lactis.*—The experiment was carried out in a similar manner, a culture of bacillus lactis grown for 14 days in broth at 20° C. being used along with the same culture of proteus as before.

One mouse was slightly ill next day but recovered. The other was found dead in 24 hours. Nothing noted on post-mortem examination. Many colonies of the same variety of proteus as had been injected were found in the gelatin cultures made from the heart-blood and from the spleen.

5. *Proteus Vulgaris plus Bacillus Aceti.*—Two experiments were carried out with these micro-organisms. In each one quarter of a cubic centimetre of a broth culture of proteus incubated for four days at 20° C., was inoculated, but the amount of bacillus aceti culture differed in the two experiments.

(*a.*) Two mice: dose of the bacillus aceti, one quarter of a cubic centimetre of a broth culture kept six days at 20° C.

One mouse remained well. The other died in 24 hours. The spleen was found much enlarged, the heart and liver engorged, and there was slight patchy congestion of the lungs. Gelatin cultures from the heart-blood and spleen yielded many colonies of the variety of proteus that had been injected.

(*b.*) Two mice: dose of the bacillus aceti, three-quarters of a cubic centimetre of the same broth culture.

One mouse was slightly ill next day but recovered. The other mouse appeared to be quite unaffected.

6. *Proteus Vulgaris plus Mycoderma Aceti.*—Two experiments were performed with these organisms. In each instance there was injected the same amount of broth culture of proteus as previously, but different doses of the other organism were given.

(*a.*) Two mice: dose of mycoderma aceti, a quarter of a cubic centimetre, mixed with the proteus and injected.

Both mice remained well.

(*b.*) Two mice: the dose of the mycoderma was three-quarters cf a cubic centimetre.

One mouse was unaffected. The other died in 24 hours. A considerable enlargement of the spleen and liver and a slight excess of peritoneal fluid were found post-mortem. Cultures from the spleen and heart-blood yielded very many colonies of the variety of proteus that had been injected.

Summary of results obtained in the series of inoculation experiments in which broth cultures of the different micro-organisms were employed;

1. Proteus only	-	1 unaffected, 1 died; death due to infection with another organism.
2. Proteus and yeast	-	1 slightly ill, 1 died.
3. Proteus and oïdium albicans	-	1 ill, 1 died.
4. Proteus and bacillus lactis	-	1 slightly ill, 1 died.
5. Proteus and bacillus aceti	-	(*a.*) 1 unaffected, 1 died.
„ „	-	(*b.*) 1 unaffected, 1 slightly ill.
6. Proteus and mycoderma aceti	-	(*a.*) 2 unaffected.
„ „	-	(*b.*) 1 unaffected, 1 died.

Conclusions from the above Inoculation Experiments.—The virulence of that variety of proteus vulgaris which was used in these experiments tends to be increased by the simultaneous injection of broth cultures of yeast, oïdium albicans, and bacillus lactis. The death of the mouse from inoculation with proteus *alone* must be regarded as due to a

secondary infection with a coccus. Small doses of the mycoderma aceti did not increase the pathogenic action of proteus, and larger doses did not increase its action to the same extent as did the smaller amounts of the other organisms employed. The larger dose of the bacillus aceti appears to have exerted an influence antagonistic to the action of the proteus organism; neither mouse died, although one was slightly ill. With a smaller dose of the bacillus aceti one mouse died, and the proteus organism was found generally distributed through its body.

Inoculation Experiments on Mice: Second Series.

Mice were next inoculated with broth cultures of proteus vulgaris, of the same variety as in the first series of experiments, mixed with the bacilli *per se;* i.e., scraped from the surface of cultures of the experimental micro-organisms on *gelatin*, on *sugar-gelatin*, or on *agar-agar*. The mixture was injected subcutaneously on the dorsum as in the former experiments.

1. *Proteus Vulgaris.*—As a control experiment, two mice were inoculated with one-quarter of a cubic centimetre of a broth culture of this microbe, incubated for four days at 20° C. Both mice were unaffected.

2. *Proteus Vulgaris plus Yeast.*—Two mice were inoculated with a similar dose of proteus broth-culture mixed with the growth of yeast from a *sugar-gelatin* culture, which had been growing for four days at 20° C.,—a large dose of the latter.

Both mice remained well for a long period. At the end of two months, one died from the effects of an abscess which formed at the site of injection.

3. *Proteus Vulgaris plus Oïdium Albicans.*—Two mice were inoculated with the same quantity of proteus broth-culture as in the first experiment of the series, mixed with the surface growth of a *gelatin* culture of oïdium albicans incubated for four days at 20° C.,—a large dose of the latter organism.

One mouse did not appear to be affected. The other died in 24 hours. Post mortem the spleen was found considerably enlarged, the liver enlarged and the right side of the heart engorged with blood. Gelatin cultures from the spleen remained sterile; similar cultures from the heart-blood yielded a few colonies of proteus.

4. *Proteus Vulgaris plus Bacillus Lactis.*—Two mice were inoculated with a similar dose of the proteus broth-culture mixed with the growth of bacillus lactis from the surface of two *gelatin* cultures, one having grown for four days, and the other for 18 days, at 20° C.

Both mice were unaffected.

5. *Proteus Vulgaris plus Bacillus Aceti.*—Two mice were inoculated with a similar dose of proteus broth-culture, and the surface growth of bacillus aceti kept for four days at 20° C.

Both mice were unaffected, with the exception that one of them in the course of a month developed a small local abscess at the site of injection.

6. *Proteus Vulgaris plus Mycoderma Aceti.*—Two mice were inoculated with a similar dose of broth culture of the proteus organism mixed with the growth of the mycoderma aceti on *sugar-gelatin*, incubated for four days at 20° C.

Both mice were apparently unaffected.

Summary of Results from the Second Series of Inoculation Experiments.—The virulence of the broth cultures of proteus was increased by the simultaneous injection of a large dose of a gelatin culture of oïdium albicans; one of the two mice experimented with died with signs of general infection. The local action of the proteus was to a certain extent increased by the simultaneous injection of the yeast organism and of the bacillus aceti; an abscess was produced at the site of inoculation in one of the two mice experimented with in each case.

Comparing these results with those obtained in the first series, in which *broth* cultures of the non-pathogenic organisms were employed, the following inferences may be drawn:—

(*a.*) Broth cultures of yeast increase the virulence of proteus to a greater extent than sugar-gelatin cultures.

(*b.*) The virulence of proteus is increased by the simultaneous inoculation of broth or of gelatin cultures of oïdium albicans, and to a greater extent by the former than by the latter.

(*c.*) The virulence of broth cultures of proteus is considerably increased by the simultaneous injection of broth cultures of bacillus lactis, but not by the injection of the bacilli alone, as, for instance, the growth from sugar-gelatin cultures.

(*d.*) The virulence of broth cultures of proteus is only slightly increased by the injection of broth cultures of the mycoderma aceti, and not at all by the injection of sugar-gelatin cultures of this microbe.

(*e.*) The virulence of proteus is not increased by the injection of sugar-gelatin cultures of bacillus aceti, nor by large doses of broth cultures of this micro-organism.

(*f.*) *Broth* cultures of the non-pathogenic micro-organisms have a greater intensifying effect on proteus injections than have the bacilli *per se*.

Inoculation Experiments on Mice: Third Series.

Mice were inoculated with definite quantities of broth cultures of bacillus coli mixed with *broth* cultures of the several non-pathogenic organisms used in the previous experiments. They were, as before, inoculated subcutaneously on the dorsum.

1. *Bacillus Coli.*—As a control experiment, two mice were inoculated with half a cubic centimetre of a broth culture of this bacillus incubated for 24 hours at 37° C. It is generally stated that mice are not susceptible to subcutaneous injection of this microbe. I found, however, that it is important to use mice of at least a medium size; if they are young and undersized they are readily killed by doses of half a cubic centimetre inoculated subcutaneously. Care, therefore, was taken to use in this and the following series of inoculation experiments mice of a good average size only.

2. *Bacillus Coli plus Yeast.*—Four mice were experimented with, each being inoculated with half a cubic centimetre of a broth culture of bacillus coli incubated for three days at 37° C., along with a similar amount of broth-culture of yeast of different ages and incubated at 20° C.

(*a.*) Two mice were inoculated with bacillus coli and broth culture of yeast kept for three days at 20° C.

One mouse did not appear to be affected. The other died in 48 hours. Nothing was found on post-mortem exami-

nation except a little enlargement of the spleen. Two gelatin cultures made from the heart-blood and from the spleen, yielded each one colony of the variety of the bacillus coli that had been injected.*

(*b*.) Two mice were inoculated with bacillus coli and with broth culture of yeast kept for 40 days at 20° C.

One mouse was ill next day but recovered. The other died in 24 hours. Post mortem its spleen was large and engorged with black blood, the liver was similarly engorged, and the right side of the heart was much distended. Gelatin cultures from the heart-blood and from the spleen yielded crowds of colonies, in pure culture, of the variety of bacillus coli that had been injected.

3. *Bacillus Coli plus Oïdium Albicans.*—Four mice were inoculated with the same dose of bacillus coli as in the previous experiments. Two of the four received also a like quantity of a broth culture of oïdium albicans incubated for three days at 20° C., and other two, in a second experiment, similar doses of a culture of seven days' growth. The results were much the same in the two experiments, with the exception that the older culture proved rather less virulent, as shown by tardier onset and the less severity of the effects produced.

(*a*.) Two mice: inoculated with oïdium culture three days old.

One mouse very ill next day but recovered. The other dead in 24 hours. The spleen was a little enlarged, the right side of the heart was engorged, and the lungs rather congested. Gelatin cultures made from the heart-blood and from the spleen yielded large numbers of colonies in pure culture of the variety of bacillus coli that had been injected.

(*b*.) Two mice inoculated with oïdium culture seven days old.

One mouse was slightly ill for a time but recovered. The other died in 48 hours, and pure cultures of the bacillus coli were obtained from the heart-blood and from the spleen.

4. *Bacillus Coli plus Bacillus Lactis.*—Four mice were inoculated each with a like dose of culture of bacillus coli as was used in the other experiments. Two received at the same time a similar dose of a three-days old broth culture of bacillus lactis, and other two a similar dose of a seven-days old culture of the microbe; both cultures incubated at 20° C.

(*a*.) Two mice: broth culture of bacillus lactis, three days old.

Both mice were ill next day but recovered.

(*b*.) Two mice; broth culture of bacillus lactis, seven days old.

The larger mouse was ill next day, but recovered. The smaller was also ill the next day, and it died in 48 hours. Post mortem the spleen and right side of the heart were engorged. Gelatin cultures from the spleen and from the heart-blood yielded a large number of colonies of the bacillus coli in pure culture.

5. *Bacillus Coli plus Bacillus Aceti.*—In these experiments the mice were inoculated with half a cubic centimetre of a broth culture of the bacillus coli incubated not at 37° C., but for four days at 20° C. The

* The tests applied in this and subsequent experiments, for the purpose of ascertaining whether the colonies of the bacillus coli, recovered from the heart-blood or spleen, were of the same variety of this microbe as that injected, were: the morphological characters of the bacillus, the nature of its growth on gelatin, the amount of gas produced by it in gelatine-shake cultures, the rate at which it coagulated milk, and the rate and amount of indol formation.

broth cultures of the bacillus aceti employed were also incubated at 20° C. All the mice were of medium size.

(a.) Two mice: control experiment.

Both died in 24 hours. In each the spleen was enlarged; in one this enlargement was much greater than in the other, and the liver and heart were engorged. Pure cultures of the bacillus coli were obtained from the heart-blood and from the spleen.

(b.) Two mice: broth culture of bacillus aceti incubated for four days at 20° C., in addition to bacillus coli.

One mouse remained well, the other died in eight hours. Its spleen was moderately enlarged and the lungs showed patches of congestion. Gelatin inoculated from the spleen and from the heart-blood yielded many colonies of the bacillus coli in pure culture.

(c.) Two mice: broth culture of bacillus aceti four weeks old, in addition to bacillus coli.

Both animals remained well.

A similar result was obtained with broth cultures of the bacillus aceti, incubated for three weeks at 20° C. From these experiments it appears that bacillus aceti from broth cultures has an action antagonistic to bacillus coli from broth cultures.

6. *Bacillus Coli plus Mycoderma Aceti.*—Two mice were inoculated each with a like dose of the same culture of bacillus coli as used in the first experiment of the present series: a like dose of a broth culture of the mycoderma aceti, incubated for three weeks at 20° C., being mixed with it.

One mouse dead next day. Only a little patchy congestion of the lungs found post mortem. Sugar-gelatin cultures from the heart-blood and from the spleen yielded a large number of colonies of the bacillus coli in pure culture.

The other mouse was very ill on the day after inoculation, and died in 48 hours. There was similar patchy congestion of the lungs, also a little enlargement of the spleen and engorgment of the right side of the heart. Sugar-gelatin cultures from the heart-blood and from the spleen yielded large numbers of colonies of the bacillus coli in pure culture.

Summary of Results of the Third Series of Inoculation Experiments.

1. Bacillus coli, recent culture	-	2	mice,	0	died,	2	unaffected.
2. Bacillus coli and yeast	-	2	"	1	"	1	"
" " "	-	2	"	1	"	1	ill.
3. Bacillus coli and oïdium albicans	-	2	"	1	"	1	very ill.
" " " "	-	2	"	1	"	1	slightly ill.
4. Bacillus coli and bacillus lactis	-	2	"	0	"	2	ill.
" " " "	-	2	"	1	"	1	"
5. Bacillus coli and bacillus aceti	-	2	"	1	"	1	unaffected.
" " " "	-	2	"	0	"	2	"
6. Bacillus coli and mycoderma aceti		2	"	2	"	–	

Conclusions from the Third Series of Inoculation Experiments.—It appears, in the first place, that the susceptibility of mice to the action of broth cultures of the bacillus coli depends on the size and age of the mice, and also upon the culture of the bacillus used. As to the latter point, it was found that a culture in broth grown for 24 hours at 37° C. was not nearly as virulent as a similar culture grown for four days at 20° C. Secondly, it appears that the virulence of the cultures of bacillus

coli is considerably increased by admixture with broth cultures of the yeast organism, and that the older cultures of this latter organism have a greater intensifying power in the above sense than more recent ones. Thirdly, the addition of the oïdium albicans exerted a like intensifying influence on bacilus coli, but the recent cultures were more potent for evil than the older ones. Fourthly, the bacillus lactis only slightly intensified the pathogenic action of the bacillus coli; one mouse only out of four, died, and that which died was rather a small one. This bacillus did not increase the pathogenic power of the bacillus coli to nearly the same extent as did the yeast and the oïdium albicans. Fifthly, the broth cultures of the bacillus aceti exert a powerful antagonistic action to the action of the bacillus coli; this antagonism is much more largely developed in the older cultures than in the more recent ones, in which it is also present. Sixthly, the virulence of the bacillus coli is greatly increased by the simultaneous injection of the mycoderma aceti.

Inoculation Experiments on Mice: Fourth Series.

In this series broth cultures of the bacillus coli were used for inoculation after being mixed with the non-pathogenic organisms, *apart from their chemical products, i.e.,* obtained from the surface of the various media on which they were grown.

1. *Bacillus Coli.*—As a control experiment, half a cubic centimetre of broth culture, incubated for 24 hours at 37° C., was injected into each of two mice. The animals were not affected.

2. *Bacillus Coli plus Yeast.*—Two mice were each inoculated with a like dose of the broth culture of bacillus coli as given to the control animals, and with the growth of yeast from two sugar-gelatin cultures, incubated for seven days at 20° C. Both became ill, but recovered.

3. *Bacillus Coli plus Oïdium Albicans.*—Two mice were each inoculated with a like dose of the culture of bacillus coli, along with the growth of two gelatin cultures of oïdium albicans, incubated for seven days at 20° C. Both were very ill the next day, but recovered.

4. *Bacillus Coli plus Bacillus Lactis.*—Two mice were each inoculated with a like dose of bacillus coli, along with the growth of two sugar-gelatin cultures of bacillus lactis, incubated for seven days at 20° C. Both mice were ill next day, but recovered.

5. *Bacillus Coli plus Bacillus Aceti.*—Two mice were each inoculated with half a cubic centimetre of a broth culture of bacillus coli, grown for four days at 20° C., and both died. The blood and spleen were found crowded with the organism injected.

Other two mice were each inoculated with a like dose of the culture of bacillus coli and with the bacilli from the surface of a sugar-gelatin culture of the bacillus aceti, incubated for a week at 20° C. Both these mice remained well.

6. *Bacillus Coli plus Mycoderma Aceti.*—Two mice were each inoculated with a like dose of the bacillus coli, along with the growth from one gelatin culture of the mycoderma aceti, incubated for four weeks at 20° C. One mouse was a little ill next day, but recovered. The other died in 24 hours. Post-mortem there was very great enlargement of the liver and spleen, especially the latter; the lungs were congested and the heart engorged; the animal was pregnant. Gelatin cultures from the heart-blood, and from the spleen yielded large numbers of colonies of the bacillus coli in pure culture.

Results of the Fourth Series of Experiments.—The virulence of broth cultures of bacillus coli appears to be increased by injecting at the

same time large doses of the microbes of yeast, of oïdium albicans, and of bacillus lactis, but not to the same extent as when these organisms along with their chemical products were used for inoculation (*vide* third series of experiments).

The mycoderma aceti from the surface of sugar-gelatin also intensifies the virulence of the bacillus coli, but not to as great an extent as does this microbe in broth culture. The bacillus aceti from sugar-gelatin exerts an action antagonistic to that of the bacillus coli. This antagonistic action is exhibited to an even greater extent than with broth cultures, and therefore depends, probably, on some constituent of the bodies of the bacilli.

Inoculation Experiments on Rabbits.

Using upon rabbits cultures of bacillus coli incubated for four days at 37° C., it was found that doses of more than one-half per cent. of the body weight were fatal within a week from the date of inoculation. Rabbits inoculated with a dose of not more than a half per cent. of their body weight were made ill and developed local abscesses; but they exhibited no general infection, and usually they recovered. This dose of the variety of bacillus coli employed for my purposes was therefore taken as the standard dose to which the non-pathogenic organisms were added in order to determine their influence on the virulence, local or general, of bacillus coli.

1. *Bacillus Coli plus Yeast.*—Two rabbits were each inoculated subcutaneously in both groins, with 0·5 per cent. of their body weight of culture of bacillus coli; and also with the surface growth from two sugar-gelatin cultures of yeast, incubated for two weeks at 20° C.

(*a.*) Weight, 612 grammes. This rabbit was a little quiet the next day, and was lame from tenderness in the groins. At the end of a week it was very thin and weak. Its weight was then 481 grammes; a loss of 131 grammes, equal to 21 per cent. of the original body weight. The animal died on the ninth day; nothing was found on post-mortem examination except local abscesses in both groins, from which pure cultivations of the variety of bacillus coli that had been injected were obtained by the inoculation of gelatin tubes. Cultures from the heart-blood yielded no colonies.

(*b.*) Weight, 549 grammes. This rabbit also became thin, quiet, and lame from tenderness in the groins at the site of inoculation. At the end of a week the loss of weight amounted to 102 grammes, equal to 19 per cent. of its original weight. Death occurred on the tenth day. Post-mortem there was considerable destruction of tissue in the right groin, with a little lymph and pus. In the left groin there was a large abscess full of liquid pus. The spleen was very small. The small intestine was rather distended with gas and liquid fæces. Gelatin cultures from the heart-blood, spleen, and intestinal mucus, yielded numerous colonies of the bacillus coli in pure culture. More colonies were present in the cultures from the pus than in those from the blood and intestinal contents.

Result.—The addition of the yeast organisms *per se* in large numbers to culture of bacillus coli increased the pathogenic effect on the rabbit of the latter organism. This increased effect resulted in much local suppurative and necrotic change in the case of rabbit (*a.*), and in similar local effects along with general infection in rabbit (*b.*). The great wasting is probably due to the local suppuration. No diarrhœa was produced.

2. *Bacillus coli plus Oïdium albicans.*—Two rabbits were each inoculated in the groins with a similar dose of the same culture of bacillus coli, along with the growth from the surface of two sugar-gelatin cultures of oïdium albicans, incubated for two weeks at 20° C.

(*c.*) Weight, 617 grammes. This rabbit was quiet on the following day and lame from local tenderness. It gradually became weaker and thinner, and died on the eighth day. Loss of weight in a week 74 grammes, equal to 12 per cent. of the original weight. Post mortem : local abscesses in both groins, largest on the right side, that being the side on which most of inoculation fluid was injected; considerable purulent lymph in the tissues; spleen not enlarged; lungs and heart normal; a little gaseous distension of the small intestine. Gelatin cultures from the heart-blood remained sterile; those from the pus in both abscesses yielded pure cultures of the bacillus coli, the colonies not being nearly as numerous as in the case of the rabbits (*a.*) and (*b.*).

(*d.*) Weight, 574 grammes. This rabbit was inoculated in the same way as the last, a like quantity of sugar-gelatin cultures of the oïdium albicans being given. The animal was not as much affected as the last. The loss of weight in one week amounted to only 30 grammes, equal to 5·2 per cent. of the original weight. Death occurred on the tenth day. Abscesses were found in both groins, largest on the right side; the intestines were a little distended with gas; the spleen, heart, and liver, were normal; a patch of pneumonic consolidation was present at the base of the right lung. Gelatin cultures from the spleen yielded many colonies of the bacillus coli in pure culture; those from the heart-blood remained sterile.

Result.—The virulence of the bacillus coli was increased by association with large amount of the oïdium albicans. This increased virulence resulted in more severe local inflammation and in destruction of tissue, the animal succumbing to the effects of this, not to any general infection. The oïdium albicans does not appear to have quite as great an intensifying effect as the yeast organism. Rabbits (*c.*) and (*d.*) did not waste to the same extent and did not die quite as rapidly as rabbits (*a.*) and (*b.*). Other two rabbits inoculated with the same dose of oïdium albicans mixed with 0·1 per cent. of the body weight of a broth culture of bacillus coli incubated for two days at 37° C., wasted to the extent of 8·4 per cent. and 7 per cent. of their weight respectively in four days, after which they again gained weight and soon recovered. Hence it is evident that the local effect produced in the rabbits (*c.*) and (*d.*) was due chiefly to the large dose of the bacillus coli and not directly to the oïdium albicans.

3. *Bacillus Coli plus Bacillus Lactis.*—Two rabbits, (*e.*) and (*f.*), were each inoculated with 0·5 per-cent. of their body weight of bacillus coli culture, and also with the surface growth of two cultures of bacillus lactis on sugar-gelatin, incubated for two weeks at 20° C. These rabbits became quiet, lame, and considerably wasted; local swelling developed in their groins at the site of inoculation. The animals began to recover at the end of a week, and eventually got quite well. Hence the bacillus lactis does not appear to increase the virulence of the bacillus coli.

4. *Bacillus Coli plus Mycoderma Aceti.*—Two rabbits were each inoculated in the groins with 0·5 per cent. of their weight of a broth culture of bacillus coli, incubated for four days at 37° C., and with the surface growth from two cultures on sugar-gelatin of the mycoderma aceti, incubated for ten days at 20° C.

(*g.*) Weight, 690 grammes. At the end of three days this rabbit was quiet, stiff in the hind legs, and had lost weight to the extent of 81 grammes, 11·7 per cent. of its original weight. In two more days it lost additional 8 grammes; in the next two days it gained 8 grammes. Hence the total loss of weight in a week was 11·7 per cent. of its weight. The animal was killed on the 14th day. It was very thin; and it had large abscesses in both groins, one of which, that on the left side, was discharging through a small orifice very offensive pus. The pus on the right side had no smell, and yielded many colonies of the bacillus coli on cultivation. There had been a further loss of 14 grammes in weight before death.

(*h.*) Weight, 661 grammes. This rabbit was quiet next day; in three days it was even more quiet and rather stiff in the hind legs, and it had lost 107 grammes in weight, 16·2 per cent. of its original weight. In two more days it lost additional 8 grammes, and in the next two another 17 grammes, making a total loss of 132 grammes in a week, 20 per cent. of its weight. The animal improved during the following week, becoming more lively and less stiff; it, however, lost another 17 grammes in weight. When killed on the fourteenth day nothing abnormal was found except a large sweet abscess on each side, largest on the left side. Cultures from the pus yielded many colonies of bacillus coli only. No colonies were obtained from the heart-blood by cultivation on gelatin and sugar-gelatin.

Result. — The mycoderma aceti did not increase the virulence of the bacillus coli, except to the extent of causing greater local suppuration and greater loss of weight.

5. *Bacillus Coli plus Bacillus Aceti.*—Two rabbits were each inoculated in the same way as before with a like dose of the culture of the bacillus coli, along with the surface growth of two cultures on sugar-gelatin of the bacillus aceti, incubated for four days at 20° C.

(*j.*) Weight, 739 grammes. At the end of three days this rabbit was wasted, was suffering from diarrhœa and had lost 138 grammes, 17 per cent. of its original weight. The diarrhœa continued, and death occurred on the seventh day, the total loss of weight being 245 grammes, 33 per cent. of its original weight. *Post mortem.*—Caseating abscesses in both groins, from which many colonies of the bacillus coli were obtained by cultivation; acute gastro-enteritis, the small intestine distended with fluid and gas, and the epithelium peeled off; patchy plastic peritonitis. Spleen and lungs normal. Right side of the heart distended with blood clot; cultures on gelatin from it yielded a few colonies of bacillus coli.

(*k.*) Weight, 557 grammes. The mixture of material was only injected into the right groin. Wasting and diarrhœa developed. Loss of weight in three days, 45 grammes, 7·1 per cent. of the original weight. Right leg stiff. During the next four days the animal improved; it gained weight, 32 grammes, and the diarrhœa stopped. Panophthalmitis developed in the right eye, and the rabbit was killed on the seventh day; total loss of weight, 13 grammes. *Post mortem.* —A small healing abscess, containing purulent lymph, was found in the right groin; nothing else abnormal. Cultures from the contents of the abscess yielded many colonies of the bacillus coli in pure culture; those from the heart-blood remained sterile.

Result.—The addition of the bacillus aceti caused, in one of these two rabbits, profound local and constitutional disturbance, resulting in diarrhœa, gastro-enteritis, rapid wasting, and death. The effect of a similar dose on the other rabbit was to cause an attack of diarrhœa, from which the animal rapidly recovered. It appears, therefore, that some other factor must have been present to render the first animal so susceptible to the combined action of the two microbes.

(*l.*) Weight, 824 grammes. Rabbit inoculated with 0·5 per cent. of its body weight of broth culture of bacillus coli, incubated seven days at 37° C., and with the surface growth on agar-agar of bacillus aceti, incubated for seven days at 20° C. Moderate diarrhœa and swelling in both groins resulted. Loss of weight in three days was 82 grammes, in another four days 81 additional grammes, making the total loss of 163 grammes in a week, equal to almost 20 per cent. of original weight.

(*m.*) Weight 687 grammes. Inoculated in the same way as rabbit (*l.*) but only in the right groin. An abscess formed at the site of inoculation and began discharging in six days. Slight diarrhœa ensued. Loss of weight, 27 grammes in the first three days, and a further 25 grammes in the next four days; a total loss of 52 grammes in a week, equal to 7·5 per cent. of the original weight.

Result. — These two experiments produced the same results as (*j.*) and (*k.*), but in a less severe form. Probably the diminished severity was due to some difference in the culture of the bacillus coli used. It is noteworthy that the wasting was very much less when the material was only injected into one groin (*e.g.*, experiments (*k.*) and (*m.*)).

Summary of the Results of Inoculation Experiments on Rabbits.

No.	Organisms injected.	Loss of Weight.	Result.	Remarks.
		Per cent.		
(*a.*)	Bacillus coli - -	21	Death (9th day).	Local abscesses.
	and			
(*b.*)	Yeast - - -	19	Death (10th day).	Abscesses and general infection.
(*c.*)	Bacillus coli - -	12	Death (8th day).	Local abscesses.
	and			
(*d.*)	Oïdium albicans -	5·2	Death (10th day).	Local abscesses.
(*e.*)	Bacillus coli - -	4·3	Ill	Recovered.
	and			
(*f.*)	Bacillus lactis -	6·7	Ill	Recovered.
(*g.*)	Bacillus coli - -	11·7	Ill	Killed on 14th day.
	and			
(*h.*)	Mycoderma aceti -	20	Ill	Killed on 14th day.
(*i.*)	Bacillus coli - -	33	Death	General infection.
	and			
(*k.*)	Bacillus aceti -	2·2	Ill	Killed; diarrhœa and local abscess.
(*l.*)	Bacillus coli - -	20	Ill	Slight diarrhœa and local abscesses.
	and			
(*m.*)	Bacillus aceti -	7·5	Ill	Slight diarrhœa and local abscesses.

APP. B. No. 5.

On the Influence of certain Non-Pathogenic Micro-organisms upon the Activities of Microbes that are Pathogenic; by Dr. Cantley.

Conclusions from the Experiments on Rabbits.—The injection of large doses of broth culture of bacillus coli alone produces local abscesses at the site of inoculation, but no general infection. The amount of local suppuration depends on the amount of the culture injected, the greater the dose the more severe the inflammation and the suppuration. A similar result obtained in all the cases of inoculation of mixed material, the suppuration being greater in the right groin, into which the larger portion of the mixture was injected, than in the left groin, which received a smaller quantity. The virulence of bacillus coli was definitely intensified by association with the non-pathogenic micro-organisms, with the exception of the bacillus lactis. A large amount of wasting occurred in most of the rabbits inoculated. Judging from the amount of wasting the pathogenic action of bacillus coli was most increased by its association with yeast, with the mycoderma aceti, and with the bacillus aceti in two cases. General infection was produced in two cases, namely, in one of two rabbits inoculated with bacillus coli *plus* yeast, and in one of four rabbits inoculated with bacillus coli *plus* bacillus aceti; in the four rabbits in question diarrhœa was induced, much more severely in one than in the other three. Thus it appears that the action of the bacillus aceti in intensifying the virulence of the bacillus coli is distinctly marked in the experiments on rabbits, whereas in the experiments on mice it appeared to have quite a contrary effect, whether broth cultures were used or whether the bacilli *alone* from the surface of sugar gelatin-cultures were injected.

APPENDIX C.

REPORTS on the INFLUENCE of GLYCERINE, of LANOLINE, and of VASELINE, in INHIBITING the GROWTH of MICRO-ORGANISMS commonly found in VACCINE LYMPH; by Dr. S. MONCKTON COPEMAN and Dr. F. R. BLAXALL.

APP. C.

On the Influence of Glycerine, &c. in Inhibiting the Growth of Micro-organisms in Vaccine Lymph; by Drs. Copeman and Blaxall.

PART I., by Dr. COPEMAN.

Account of the Microbic Constituents of Vaccine Lymph, with History of the various Methods experimentally undertaken, in this and other Countries, for separating from Vaccine Lymph extraneous Micro-organisms, and for preserving indefinitely its Specific Property.

In a paper presented to the International Congress of Hygiene held in London in 1891, and subsequently published in the Transactions of that Congress, attention was called to a special method which I had devised for the bacteriological purification and for the preservation of vaccine lymph.* This method consisted in the intimate admixture of a given amount of lymph, or rather vesicle pulp, with twice its quantity of a 50 per cent. solution of chemically pure glycerine in distilled water, and in subsequent storage of the resulting emulsion in sealed capillary tubes for several weeks.

For some years antecedent to 1891, I had been engaged in investigating the nature and mode of action of the specific virus contained in vaccine lymph, and, in view of the earlier work on this subject by Chauveau† and Burdon Sanderson‡ having afforded presumption of the particulate nature of the specific virus of vaccinia, my special attention had been directed in the first instance to the bacteriological side of the inquiry.

With reference to the literature of the subject, the first account of the discovery of micro-organisms in vaccine lymph and in small-pox lymph appears to be that given by Keber§ of Danzig, who evidently regarded the bodies found by him as the carriers, if not the actual generators, of the virulent principle of these diseases.

Within the next two years the occurrence of similar bodies in vaccine lymph was described by Burdon Sanderson and by Klebs. In 1872 an important paper was published by Cohn‖ of Breslau, in which he treated the morphological aspects of the subject with much completeness. His observations, which related to both vaccine lymph and variolous lymph, have, as regards the lymph obtained from mature vesicles, at least, received general corroboration from all subsequent workers. He, however, apparently believed the micro-organisms found by him to be of one species only, to which accordingly he gave the name micrococcus vaccinæ or variolæ, as the case might be, whereas later observers have shown that organisms of more than one species are usually to be found in any given specimen of lymph.

Cohn called attention to the fact that in perfectly fresh vaccine lymph the "corpuscles" for the most part occur singly, but that others

* See also Proceedings of Royal Society, vol. 54, p. 189.

† Comptes Rendus, lxvi., 1868.

‡ Intimate Pathology of Contagion: 18th Report of the Medical Officer to the Privy Council.

§ Virchow's Archiv., xlii., 1868.

‖ *Ibid.*, lv., 1872.

App. C.

On the Influence of Glycerine, &c. in Inhibiting the Growth of Micro-organisms in Vaccine Lymph; by Drs. Copeman and Blaxall.

are joined together in pairs in a form resembling the figure 8; and he states that after the lymph has been kept for a time, the numbers of "the "double cells, increase, and soon, chains of four begin to be distinguish-"able. These chains are usually curved, or in zigzags; their attach-"ment one to another is evidently very slight, as they can readily be "displaced . . . . After a few hours' observation they are seen "to be all aggregated into irregular colonies or clumps, each consisting "of 16, 32, or more corpuscles." He also noted a point of importance in connexion with the opacity which is apt to occur in stored lymph, namely, that "in capillary glass tubes the multiplication of colonies "sometimes lasts a long time so that they acquire considerable size, "and present themselves as flocculi."

Just previously there had appeared a short communication by Weigert,* who investigated the histology of the vaccine vesicle, with the result that he found the lympathic vessels of the cutis plugged, during the early stages of the process, with granular masses of what appeared to be micrococci.

About twelve years later, Quist† published a series of experiments dealing with the possibility of cultivating, outside the animal body, the micro-organisms present in vaccine lymph. The culture fluid employed by him was composed of equal parts of blood-serum, glycerine, and distilled water, this mixture being rendered alkaline by the addition of $\frac{1}{300}$th part of carbonate of potash. Quist did not attain any great measure of success in the immediate object of this inquiry, but still, he showed that the specific contagium of vaccinia could exist, for a time at any rate, in a fluid containing a considerable proportion of glycerine.

Buist‡ of Edinburgh succeeded in isolating from vaccine lymph three varieties of micrococci which, when grown on nutrient media, gave rise to colonies of a white, yellow, or orange colour. All these Buist appears to have considered to be essential constituents of vaccine lymph, as is evidenced by the fact that he speaks of them as white, yellow, and orange vaccine respectively.

It was reserved for Pfeiffer§ to show that the various micro-organisms isolated by his predecessors, although to be found constantly in lymph, were identical with certain definite species with which he was familiar as occurring also in various tissues and body fluids under circumstances which had no relation either to vaccinia or variola. As a consequence, none of these organisms are, he pointed out, to be regarded as concerned in the specific action of the lymph.

Mention may also be made of the fact that Crookshank in his evidence before the Royal Commission on Vaccination, and also in a paper communicated by him to the International Congress of Hygiene, in 1891 (vol. iii.), states that he has succeeded in isolating from vaccine lymph, by the method of plate cultivation, an immense number of bacteria, including micrococci, bacilli, torulæ, &c., of which he set out a detailed list. All of these he recognises as well-known saprophytic bacterial forms, associated, some of them, with processes of suppuration, but none of which, he says, can be regarded as the contagium of vaccinia, seeing that no single one of them is constantly present in vaccine lymph, human or bovine. As regards the latter statement, I find myself entirely in agreement with him. For the rest, his formidable list of bacteria to

* Centralb. f. Bakt., 1871, p. 609.
† Berlin, Klin. Woch., 1883, No. 52.
‡ Vaccinia and Variola, Edinburgh, 1886.
§ Zeitschrift. f. Hygiene, iii., 2, p. 189.

be obtained from vaccine lymph is discounted, as regards danger incurred in the operation of vaccination, by the fact that he is silent as to whether any, and if so what, precautions had been taken by him with regard to the collection of the lymph which he tested. Nor did he attempt to distinguish between those bacteria which are commonly to be found in lymph and those whose presence therein is exceptional.

As the result of my own work in this connexion, it would appear that in addition to a small bacillus described elsewhere both by Klein and myself, and believed by us to be essential to vaccinia, there are at least three species of micro-organisms, one or more of which species are almost universally to be found in every sample of human or calf vaccine lymph examined. These are, staphylococcus albus epidermidis, S. pyogenes aureus, and S. cereus flavus; and they correspond probably to Buist's white, orange, and yellow vaccine respectively. Of these, the staphylococcus albus epidermidis is usually to be found in the upper layers of healthy skin of unvaccinated persons. In addition, I have been able to satisfy myself as to the occasional presence of the streptococcus pyogenes. I myself have never detected the streptococcus of erysipelas; but it is on record that, in certainly one instance at least, this microbe has been isolated from vaccine lymph.

Early in the course of my experiments it struck me that the exuberant growth commonly manifested by these evidently "extraneous" organisms, might very possibly be interfering with, if not superseding, the more important and essential organism that I was seeking. I therefore turned my attention to the discovery, if possible, of some means of so treating vaccine lymph as to inhibit the multiplication in it of "extraneous" organisms without at the same time injuring its potency for vaccination.

Another consideration which directed my research work at that time in the direction indicated, was, that my attention had been called to the opacity which commonly occurs, after a longer or shorter period, more particularly in human lymph which has been stored in sealed capillary tubes, as well as to the deterioration in activity of the lymph which is found to be a concomitant of such opacity. As to this, I have in the course of my investigations been able to show that the opacity of old stored lymph may be quite independent of any coagulation in the lymph, no coagulum being found on breaking many of the tubes in which opacity was most marked. Further, I have shown that if cultivation experiments are carried out with the contents of tubes which have become opaque, and also simultaneously, for purposes of control, with samples from tubes of comparatively fresh lymph, many more colonies are likely to result in the plates established from the old tubes than in those established from more recently stored lymph. There can hardly be question, therefore, that the opacity of old stored lymph is, in the main, the outcome of the multiplication in it of aërobic bacteria, the ancestors of which were present in the lymph when first collected, although their numbers were then so comparatively small as not to render it in any way turbid. These bacteria evidently find in the lymph, especially when removed from the body, a suitable medium for their subsequent multiplication, while at the same time it would appear that growth and multiplication of them has the result of gradually inhibiting the specific effect proper to the vaccine virus itself.

Upon all grounds, then, the obvious indication for my guidance was not only to prevent such multiplication of "extraneous" organisms subsequent to storage in the usual manner, but, if possible, to remove

APP. C.

On the Influence of Glycerine, &c. in Inhibiting the Growth of Micro-organisms in Vaccine Lymph; by Drs. Copeman and Blaxall.

them altogether, as soon as the lymph was taken from the living subject, without injury to the actual contagium of vaccinia.

Without detailing the various experiments adopted with this object in view, a full account of which has been published elsewhere, it is necessary in this place to state briefly the lines on which the work was carried out. In the first place, trial was made of the method of exposure of lymph, for definite periods, to a temperature considerably above blood-heat, which had, in the hands of Kitasato, met with such brilliant success in the isolation of the bacillus of tetanus. Proceeding in this manner, and in every experiment observing the precaution of making control cultures, I presently arrived at a temperature, exposure to which is apparently incompatible with the continued existence of those micro-organisms which can ordinarily be grown when vaccine lymph is inoculated into nutrient jelly. The temperature in question ranged between 38° C. and 42° C. But the method did not in practice prove advantageous. Thus, if plate culture were made of lymph, after exposure for an hour at the lower register, a few points of growth occasionally, after the lapse of a day or so, made their appearance; and, on the other hand, the higher temperature, though it inhibited all extraneous microbes, appeared sometimes to exert an injurious effect on the lymph, as far as regards the normal vesiculation which should result from its inoculation in the living animal. Some method of readier application and requiring less delicate manipulation was, therefore, obviously desirable. This I at length found in the addition to the lymph, or rather to the vesicular pulp obtained from a vaccinated calf, of a sterilised 50 per cent. solution of chemically pure glycerine in distilled water prior to storage of the mixture in capillary tubes, which had been themselves previously sterilised by heat.

Admixture of glycerine and vaccine lymph is, of course, no new device. Many years ago, Müller* showed that vaccine lymph might be diluted with three times its bulk of glycerine, and still retain its properties unimpaired; a fact which has been taken advantage of at many of the Continental vaccine stations, and by more than one purveyor of trade lymph. Curschmann, writing on the subject of small-pox in Ziemssen's Encyclopedia, refers to this method as follows:—

"Müller has the great credit of having discovered the fact that by mixing vaccine matter with glycerine in certain proportions, the activity of the former is not diminished, so that we have here a means of *increasing the volume of the lymph* when the quantity is small, or when there is an unusual demand for it. . . . . The lymph and glycerine mixture *appears to keep as well as the unmixed lymph.*"

But from this statement it is quite obvious that the sole object of employing glycerine in the manner described was to increase the amount of material available for vaccination. With this same end in view, glycerine was used by Dr. Stephen Mackenzie, at the London Hospital,† in the epidemic of 1870–71, the mixture being made up immediately before it was required for a large series of re-vaccinations. Similar means for increasing their amount of available lymph have been frequently employed by public vaccinators and others in times of stress, but, until recently, altogether without appreciation of the inhibitory action exerted by the glycerine in bringing about bacteriological

* Vierteljahrschr f. gerichtl. und öffentl. Med., 1869, Bd. II.

† Vaccination with Lymph diluted with Glycerine, "Lancet," February 18th, 1871.

On the Influence of Glycerine, &c. in Inhibiting the Growth of Micro-organisms in Vaccine Lymph; by Drs. Copeman and Blaxall.

purification of the lymph when the mixture is stored, for some time prior to use, under conditions preventing access of air and light.

When, however, a glycerine emulsion is properly prepared after the method I have advocated, it is found that the growth of extraneous aërobic bacteria is at once greatly inhibited, while, after a longer or shorter period, they are practically all killed out. This effect is best demonstrated by making a series of plate cultivations from tubes of glycerinated lymph, at gradually increasing intervals of time, a control plate being poured in each instance from a specimen of the lymph material prior to the admixture of glycerine.

These observations of mine, since their publication in 1891, have received ample corroboration from a number of observers in various parts of the world, as follows:—

In 1892, a paper dealing with this question was published by MM. Chambon and St Yves Ménard,* in which they relate their experience of the use of glycerinated calf lymph when kept for a considerable period in capillary glass tubes (previously sterilised) closed by the blow pipe. Not only were the results they obtained with originally active lymph highly satisfactory, but lymph which, in its fresh state, had given mediocre results, produced after 15 days' admixture with glycerine a passable vesicle, and, after 40, 50, or 60 days, a typical one: The improvement in the activity of such lymph seemed to them to be due to the gradual extinction of extraneous microbes under the combined influence of glycerine and time. Professor Straus, who made plate cultures with their glycerinated lymph, found that when fresh it gave rise to numerous colonies of various microbes, especially staphylococcus pyogenes aureus and staphylococcus albus; but that when it had been stored 50 to 60 days, plate cultures therefrom remained absolutely sterile as regards these extraneous microbes. Samples tested at intervals between these two extremes presented fewer and fewer microbes as they became older. These experiments were repeated many times, and invariably with similar results.

This evidence, so entirely corroborative of my own work, is the more important as it appears certain, from a perusal of their original paper, that the authors were ignorant that similar results had been previously arrived at, and that these had been published nearly 12 months before the appearance of their article.

The value of glycerine in this connexion is also strongly advocated by Leoni in a paper read before the Medical Congress held at Rome in April 1894, and afterwards published in the "Revue d'Hygiène."† He finds that vaccine lymph as freshly collected is apt to contain large numbers of micro-organisms, some of which are capable of exerting pathogenic properties when inoculated into the system along with the true vaccine virus. And he states that these microbes disappear completely from, or that at the least their number is vastly decreased in, vaccine which, having been prepared with glycerine, is preserved for a period of from one to four months before use.

His conclusions may perhaps be best given in his own words:—

"Le vaccin récemment recueilli est un vaccin contaminé";

"Les agents de la contamination s'épuisent dans le vaccin conservé pendant quelque temps dans la glycérine";

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* "Gazette des Hôpitaux," December 15th, 1892, p. 1346.

† "Revue d'Hygiène," August 20th, 1894, p. 692.

APP. C.

On the Influence of Glycerine, &c. in Inhibiting the Growth of Micro-organisms in Vaccine Lymph; by Drs. Copeman and Blaxall.

"Le vaccin conservé dans la glycérine pendant 1 à 4 mois après la récolte représente le type du vaccin *pur*, d'une *virulence uniquement spécifique*";

"C'est de cette qualité de vaccin que l'hygiéniste doit aujourd'hui tenir compte dans la prophylaxie de la variole."

Klein* also bears testimony to the power exerted by glycerine in freeing vaccine lymph from bacteria. In speaking of the organism specific to vaccinia as being probably a spore-bearing bacillus, he says: ". . . . it is established that the active principle of vaccine is " preserved in glycerine, although, as is also known, pure glycerine " acting for long times is a germicide for cocci and sporeless bacilli."

In 1896, a Commission under the presidency of Dr. Schmidtmann, and including Drs. Koch, Pfeiffer, and Frosch, together with the directors of the Vaccinal Institutes of Berlin, Cologne, and Stettin, was appointed by the German Government to inquire and report as to the best methods for the collection, preservation, storage, distribution, and use of vaccine lymph. In their report, which has been recently published, the Commissioners arrive at the conclusion (among others) that fresh lymph contains numerous microbes, the number of which, on the addition of glycerine, diminishes as the age of the mixture increases. The microbes that they isolated included mould-fungi, torulæ, sarcinæ, different varieties of proteus, and numbers of bacilli and cocci. Most of these bacteria were of a saprophytic nature, but single colonies of staphylococci pathogenic for rodents† were found in 5 out of 18 samples of lymph examined. To determine to what extent glycerine is efficacious in destroying the vitality of various definitely *pathogenic* microbes, numerous streptococci and diphtheria bacilli were mixed with specimens of lymph. As a result, the streptococci were killed in 11 days and the diphtheria bacilli in 20 days. Dr. Schultz, the director of the Berlin Institute, found that keeping for a few days, after admixture of the lymph with glycerine, sufficed to destroy most of the bacteria usually present, and that their destruction was more rapid when glycerine was present to the extent of 60 per cent. than when the proportion reached 50 per cent. only.

Attempts by these experimenters to make other chemical agents serve for rendering vaccine lymph free from bacteria led to no results of value. Although the lymph could thus be rendered free from extraneous bacteria it was found to be inefficacious as vaccine.‡ Their next procedure was to determine the amount of glycerine that could be added to lymph so as to exert a powerful action in purifying it from extraneous microbes, without in any way interfering with its specific action when employed for the vaccination of children or calves, and they found that addition of glycerine with distilled water, to the extent of from 15 to 20 times the weight of the vesicle pulp collected, in no way interfered with the value of the material for the purpose of the protection which can be afforded by vaccination.

By consent, therefore, of a large number of observers fully qualified to judge of the matter, we have, in glycerinated calf lymph properly prepared, a vaccine material which, while even more efficient as vaccine than the original lymph, can be produced practically free from

* Micro-organisms and Disease, 1896, p. 399.

† It is pointed out by the Commission that no comparison can be drawn between the virulence for the human being of lymph-bacteria and that evidenced by their action on the lower animals.

‡ *Cf.* Kitasato, "Sei-i-kwai Medical Journal," October 17th, 1896.

the extraneous organisms which, at one time or another, have been isolated from fresh or stored lymph by the method of plate cultivation.*

Of not least importance is the fact that, as shown by Dr. Blaxall and myself,† nutrient material may, by this method of preparation with glycerine, be rendered free also from pathogenic bacteria, such as those of tubercle and erysipelas, even when these have previously been added in considerable quantity, for experimental purposes.

The question of quality of vaccine lymph naturally engaged the attention of the English Royal Commission on Vaccination at the time they were taking the evidence of witnesses, and among the recommendations contained in their final report is one to the effect that no person should be required to submit to vaccination by means of any other lymph than that derived from the calf. The reason for this recommendation appears to be avoidance of even remote risk of inoculation, in the process of vaccination, of infections other than cow-pox, such, for instance, as those of syphilis and leprosy (section 433); as also the desirability of minimising the opportunity for infection by erysipelas, by obviating the necessity for opening vaccine vesicles involved in arm-to-arm vaccination (section 447). The succeeding section of the report, which deals more especially with the subject discussed in the present paper, may be set out in full. It is as follows:—

> 448. "We think that safety would be increased by preserving the lymph in tubes instead of on 'dry points.' There is some difference of opinion on this matter amongst those with whose opinions we have been furnished. On the whole, however, we think the weight of experience as well as reason is in the direction we have indicated.
>
> "In connexion with this subject, our attention has been drawn to the experiments recently made by Dr. Copeman, as to the effect of the storage of vaccine lymph in glycerine. The conclusions at which he arrives are that the addition of glycerine, whilst it leaves the efficacy of the lymph undiminished, or even increases it, tends to destroy other organisms. If it be the fact that the efficacy of the lymph remains unimpaired, its storage in glycerine would largely diminish the difficulties connected with the use of calf lymph, which are inseparable from *calf-to-arm* vaccination. The investigation has not reached a point at which it is possible to pronounce with certainty whether the anticipated results would be obtained. And it was at one time suggested that the introduction of glycerine was likely to be mischievous. The question is one a further investigation of which is obviously desirable.
>
> "If lymph is to be preserved in glycerine, due care would be requisite to ensure its purity, and the absence of contamination in its introduction."

To the particular sentence in the section 448 of the Royal Commissioners' Report quoted above, "And it was at one time suggested that "the introduction of glycerine was likely to be mischievous," some special reference is desirable.

The Commissioners had in view an outbreak of disease, having the clinical characters of impetigo, which occurred in the summer of 1885 in

* An exception is bacillus subtilis—the common hay bacillus—the spores of which are very resistant to the action of glycerine. This microbe, however, possesses no pathogenic properties, and as it is probably derived from the surface of the skin of the calf it is compartively easy to eliminate it by a proper method of lavage of the animal's abdomen prior to collection of the lymph.

† Paper read before Physiological Section of the British Association: Liverpool Meeting, September 1896.

villages situated on the island of Rügen in the Baltic, among 79 children vaccinated in the latter part of June of that year. This outbreak forms the subject of a paper by the late Sir George Buchanan in the Transactions of the Epidemiological Society for 1885–86. He states that for the vaccination of these 79 children only two tubes of lymph (of human origin) were available, and that consequently their contents were further mixed with glycerine ("glycerinum purissimum") before use. Thymol, to the extent of one-third, had been added to the lymph previous to its having been sent out from the Government establishment at Stettin, and before its admixture with glycerine. The German Commission appointed to inquire into the outbreak appears to have suspected the added glycerine as having contaminated the lymph, but Sir George Buchanan notes certain points in the circumstantial evidence, not inconsistent with the Stettin mixture having, *before glycerine had been added to it*, contained deleterious matters. However this may have been, I was asked, in giving evidence before the Royal Commission on Vaccination in 1893, whether the facts respecting this vaccinal impetigo at Rügen did not discount my suggested use of glycerine in connexion with lymph supplies. I pointed out, however, that in the first place, dilution of lymph with an indefinite quantity of "glycerine" of unknown composition, immediately before employing the mixture for vaccination, was a very different matter from storing, for a length of time before use, lymph with chemically pure glycerine in definite amount and of definite strength, and duly protecting the mixture from light and air.* Further, I pointed out that what, at the time of the outbreak in question, may have been termed "glycerinum purissimum," would, in all probability, at the present day be considered by no means deserving of that term. This latter statement I made on the authority of Messrs. Price, the chief manufacturers of glycerine in this country, whose manager, at the request of his directors, was good enough to put at my disposal his extensive practical knowledge of the details and the literature of this subject. The information thus obtained has been included in the appendix to the last volume of evidence shortly to be issued by the Royal Commission on Vaccination.

The glycerine employed by me in my investigations has been that manufactured in this country by Messrs. Price; but in Germany, where my method of purification and preservation of lymph is now universally adopted in the Government establishments for the supply of vaccine lymph, an Austrian glycerine made by Sarg of Vienna is used. This is said by Dr. Schultz, the director of the Berlin establishment, to be of a less "drying" nature than English glycerine.

In order to obtain an authoritative judgment on the degree of chemical purity secured in the manufacture of glycerine at the present time, and for the purpose also of accurately determining the difference, if any, in the nature of the English and Austrian brands, I induced Dr. Wilson Hake to analyse samples of glycerine manufactured by Messrs. Price and Sarg, respectively, and samples also of a new English brand which has just been placed on the market by Messrs. Lever Brothers. The results of the chemical examination of these samples, which through the kindness of Dr. Hake I am able to append, prove incontestably that all three samples, especially that of Messrs. Price, exhibit a high degree of purity. In all there is complete absence of metallic

* As the result of a recent visit to a number of Continental Vaccine Establishments I have learnt, in addition, that, even at the present day, it is not customary to sterilise the mixture of glycerine and water prior to admixture with the vaccine material. Such sterilisation is, in my opinion, of considerable importance.

App. C.

On the Influence of Glycerine, &c. in Inhibiting the Growth of Micro-organisms in Vaccine Lymph; by Drs. Copeman and Blaxall.

contamination of any kind, while the amount of organic impurity is insignificant. The main difference observed is the slightly greater degree of concentration obtained in the English products as compared with that of Austrian manufacture.

In accordance with the suggestion contained in section 448 of the Commissioners' Report, the Board made arrangements with Dr. Blaxall, the Lecturer on Bacteriology at Westminster Hospital, to carry out a series of experiments, with the object of elucidating more fully the comparative values of the glycerine method and other methods for the purification and preservation of vaccine lymph. In Dr. Blaxall's report, which is appended, it will be found that he has investigated the action on vaccine material, not only of glycerine, but also of lanoline and vaseline, substances which within quite recent years have been introduced by two officers of the Indian Medical Service, Surgeon Lieut.-Colonel King* and Surgeon Major Bamber,† respectively, as being superior to glycerine as agencies for the preservation of vaccine. Neither of these observers bring forward any bacteriological evidence as to the germicide action of the substances they advocate, as will be seen on reference to their original papers; a point of view from which, as Dr. Blaxall shows, lanoline and vaseline are to be regarded as possessing little if any value. Indeed it would appear that the "extraneous" organisms originally present in the lymph with which they are admixed, so far from exhibiting, as time goes on, any diminution in number, tend on the contrary to become largely increased, as shown by the test of plate cultivation.

Lanoline and vaseline are thought, by their advocates, to possess superiority over glycerine mainly for the following reason. These officers note that a glycerine emulsion tends to become mouldy after a short period, whereas this they do not find to be the case when either lanoline or vaseline is employed. That glycerinated lymph should have suffered deterioration in the way they indicate suggests either that it was not properly prepared or that it was left exposed to the air. That the occurrence of a similar accident is not an impossibility with lanoline and vaseline preparations is demonstrated by Dr. Blaxall's experience, as set out by him in his report.

Addendum.

Report by Dr. Wilson Hake on three Samples of Glycerine submitted to him by Dr. Copeman.

Sample A.—Glycerine dest: chem: pur. F. A. Sarg (Patent), Wien.

Sample B.—Glycerine, Price's pure, London. } Baird and Tatlock, Glasgow.

Sample C.—Glycerine, Lever Brothers' pure, Birkenhead. } Baird and Tatlock, Glasgow.

——	A. (Sarg.)	B. (Price.)	C. (Lever.)
Specific gravity	1·2547	1·2600	1·2590
Water	2·84 per cent.	0·64 per cent.	1·74 per cent.
Ash	0·00 „	0·00 „	0·00 „
Glycerine	97·16 „	99·36 „	98·26 „
	100·00	100·00	100·00

* Madras Government Order, No. 2406|L., September 20th, 1890, and "Indian Medical Gazette," December 1896.

† Vaseline Vaccine, Rawalpindi, 1896.

All three samples may be regarded as very pure examples of commercial glycerine which has evidently been refined by distillation. They are colourless and of high specific gravity (sp.gr. of pure anhydrous glycerine = 1·264). They are free from mineral impurities of any kind and are neutral in reaction. Sample B. is the best, and C. stands intermediate between A. and B. There is a slight trace of organic impurity in all, but more pronounced in A. and C. than in B.

H. Wilson Hake.

Westminster Hospital Medical School,
Caxton Street, S.W., March 17th, 1897.

Part II., by Dr. F. R. Blaxall.

A Record of Experiments on the Action of Glycerine, Vaseline, and Lanoline, on Vaccine Material derived directly from Calves.

The glycerine used was Price's "Pure Glycerine," having a sp.gr. of 1·260. It was thoroughly mixed with sterilised distilled water to 50 per cent., by weight, and the resulting mixture was again sterilised.

The vaseline used was "Pure Vaseline," which, when bacteriologically tested, had been found to be sterile. The lanoline used was "Pure Lanoline," and this also had been found to be sterile.

The vaccine material was collected from calves which had been vaccinated in the ordinary course at the Animal Vaccine Establishment, Lamb's Conduit Street, W.C. Lymph from these same calves was being used as the current supply at that station. In the first three experiments, the vaccine material was collected 120 hours after vaccination of the calf; in the fourth experiment, 96 hours after vaccination.

The vaccine material of experiment was procured in the following manner:—The vaccinated surface of the calf was well cleansed with water, and the crusts on the vesicles wiped off with a clean towel. Next the vesicles were scraped with a sterilised knife, and the scrapings thus obtained were received into a sterilised stoppered bottle of known weight.

This bottle, with its contents, was then immediately taken to the laboratory and the experiment proceeded with.

Experiment I.—The vaccine material (120-hour lymph) from the bottle was divided into three equal parts by weight; division being effected expeditiously, under cover, and with sterilised instruments, so that no contamination of the vaccine might take place. Each separate portion of lymph was then rubbed up in a sterilised mortar (as before, under cover), and was mixed with the chosen vehicle for its dilution. Complete distribution of the vaccine material throughout the vehicle was obtained in each instance by prolonged rubbing. In this way:—

1 part was mixed with 4 times its weight of 50 per cent. glycerine in distilled water; so that the resulting emulsion contained 40 per cent. of glycerine;

1 part was mixed with 4 times its weight of vaseline undiluted, so the resulting emulsion contained 80 per cent. vaseline;

1 part was mixed with 5 times its weight of lanoline undiluted, so that the resulting emulsion contained 83·3 per cent. of lanoline.

Immediately satisfactory emulsions had been in each instance obtained, a definite amount of nutrient agar-agar contained in a test tube, and

APP. C.

On the Influence of Glycerine, &c. in Inhibiting the Growth of Micro-organisms in Vaccine Lymph; by Drs. Copeman and Blaxall.

which had just previously been liquefied and then allowed sufficiently to cool, was inoculated with emulsion, was well shaken up, and poured on a plate. Inoculation of the agar was effected by means of a looped platinum needle; the same needle with the same loop being used for all the experiments. The number of loopfuls thus taken from any one emulsion was intended to be equivalent to one loopful of the undiluted vaccine material. Thus of the diluted glycerine emulsion, 5 loopfuls were taken; of the vaseline emulsion, 5; and of the lanoline emulsion, 6.*

Three plates of nutrient agar-agar were established in the above fashion from each emulsion; the second plate being set up through the medium of three loopfuls of material from the test tube whence the first plate was poured, and the third plate being established in like manner from the test tube for the second plate.

The stock vaseline and lanoline emulsions were then placed in sterilised bottles duly stoppered. The stock dilute-glycerine emulsion was placed in a sterilised test tube plugged with cotton wool. All were stored in a cool cupboard in the dark.

The several agar plates were, after solidifying, placed for 24 hours in an incubator at 37° C., and then for 6 days in an incubator at 20° C. At the expiration of that time the several plates were photographed.

In this first experiment, it was found, after 6 days incubation at 20° C., that the *first*, or original agar plates in all three series, were so densely crowded with colonies as not to promise good pictures. Wherefore the *second* plates, or "first dilutions" of the original agar tubes were alone photographed. A rough counting of the colonies on these second plates, which had been established immediately after emulsification was effected, gave the following numbers:—

Glycerine (plate II.)	1,000	colonies per plate.
Vaseline (plate II.)	400	" "
Lanoline (plate II.)	700	" "

One week after making the emulsions further plates were established in the same manner, with the same number of loopfuls from the stock emulsions. These plates showed an increase in the number of colonies in samples from the vaselinated and lanolinated emulsions, but a decrease of colonies in the sample from the glycerinated emulsion. Similarly with plates made a *fortnight* and *three weeks* after making the emulsions, the colonies from the glycerinated material were fewer, whilst those from the vaselinated and lanolinated sources much more numerous than before.

At the end of *four weeks* none of the plates established from the glycerine stock emulsion showed any colonies at all; but at this date plates from the vaseline and lanoline emulsions still showed increase of colonies.

At the end of *six weeks*, plates from the glycerine stock emulsion were again found free from extraneous organisms, whereas plates from the lanoline and vaseline stock emulsions were crowded with colonies. A rough counting of the plates gave at this date—

Glycerine (plate I.)	0	colonies per plate.
Vaseline (plate II.)	8,000	" "
Lanoline (plate II.)	10,000	" "

With this glycerinated lymph, 5 weeks after making the emulsion, Dr. Cory vaccinated six children, each by five insertions. All the children's arms "took"; one in five places, three in four, one in three, and one in two places. This rather poor result was in all probability

* A "loopful" may be taken to represent about 0·005 of a cubic centimetre.

APP. C.

On the Influence of Glycerine, &c. in Inhibiting the Growth of Micro-organisms in Vaccine Lymph; by Drs. Copeman and Blaxall.

due to the fact that the glycerinated lymph had been stored in a test tube to which air had access through the cotton wool plug; moreover the emulsion in the test tube was freely movable when the latter was handled, thereby causing undesirable exposure to air. Further experiments have led to the conclusion that the glycerinated material preserves its activity best when stored, as originally suggested by Dr. Copeman, in capillary tubes, or in small pipettes, where the fluid can have very little air in contact with it.

Figs. 1, 3, and 5 are reproductions of photographs of the *second* agar plates incubated for seven days subsequent to inoculation with material from glycerine, vaseline, and lanoline emulsions which had not been stored after manufacture. All three plates show a copious growth of extraneous microbes.

Fig. 2 is a reproduction of a *first* agar plate derived from the stock glycerine emulsion after the latter had been stored 4 *weeks*. No growth whatever has occurred. Figs. 4 and 6 are representations of *second* plates of the vaseline and lanoline stock emulsions after they had been stored for *six weeks*.

These are seen to be crowded with colonies of extraneous microbes.

Experiment II.—Scrapings of vesicles were collected from a calf 120 hours after vaccination, with the same precautions as in Experiment I. As before, the vaccine material was weighed, rubbed up in a mortar, and thoroughly mixed with four times its weight of 50 per cent. sterile glycerine and distilled water. The emulsion was then drawn up into capillary tubes and into small pipettes, and stored.

Fig. 7 is a reproduction of a photograph of an agar-agar plate (after incubation for 24 hours at 37° C. and for six additional days at 20° C.) which had been inoculated with one loopful of the rubbed-up vaccine material prior to its admixture with the glycerine. Fig. 8 represents a similar plate inoculated with five loopfuls of the same emulsion immediately after glycerination. The number of colonies on the two plates will be observed to correspond closely.

Fig. 9 represents an agar-agar plate (as before, after incubation for seven days) which had been inoculated with five loopfuls of the stock glycerinated emulsion *one week* subsequent to its manufacture. The number of colonies is observed to be slightly diminished.

Fig. 10 represents a similar plate set up a *fortnight* after glycerination. A further decrease in the number of colonies is now very conspicuous. Such decrease is even more marked after a lapse of *three weeks*, as is shown by Fig. 11.

At the end of *four weeks*, the agar-agar plate inoculated from the stock glycerine emulsion was found free from extraneous organisms, Fig. 12.

Some of this particular emulsion, contained in a capillary tube, was now used by Dr. Cory to vaccinate three infants. All three "took" well, each in five places. Fig. 13 is a reproduction of a photograph of one of these children's arms, taken on the 8th day.

Experiment III.—Scrapings of vesicles were collected from a calf 120 hours after vaccination, with the same precautions as before. These were weighed, rubbed up, and diluted with 15 times their weight of 50 per cent. sterile glycerine and distilled water; so that the per-centage of glycerine present became 46·9. One loopful of this emulsion, immediately after glycerination, was inoculated into nutrient agar-agar, and plates were established therewith. Plates established from the stock

glycerine emulsion a week, a fortnight, three weeks, and four weeks, respectively, from commencement of storage, showed as regards the first three, week by week, a rapid diminution in the number of colonies which appeared after incubation in the manner described, while the fourth was found to be quite free from extraneous organisms.

Some of this glycerine emulsion, four weeks after manufacture and storage in a pipette, was used by Dr. Cory and by Mr. Stott, at the Animal Vaccine Establishment, Lamb's Conduit Street, for the vaccination of 65 infants. All these children's arms took, Dr. Cory obtaining, in his series of 36 cases, 100 per cent. of insertion success. Of the total number, 54 were successful in five places, two in four, two in three, and one in two places. Fig. 14 is a reproduction of a photograph of one of these children's arms, taken on the tenth day of vaccination. Some of this emulsion was also used to re-vaccinate a groom at the Brown Institution. In this instance also the arm "took" excellently.

Experiment IV.—Scrapings of vesicles were obtained from a calf 96 hours after vaccination, the same precautions being taken as before. This material was weighed and divided into three equal parts. One part was emulsified with four times its weight of 50 per cent. glycerine and distilled water; one part with four times its weight of vaseline undiluted; and one part with five times its weight of lanoline—as in Experiment I. Agar-agar plates were established from these emulsions antecedent to their storage, and the numbers of colonies which appeared on the several plates at this stage were found in close agreement. The three emulsions were then placed in sterile stoppered bottles, some of the glycerinated material being also stored in capillary tubes and in pipettes. It was designed to repeat No. 1 Experiment with these emulsions, and sample plates were again established from them after they had been stored a week. Again the vaseline and lanoline plates showed at this stage an increase in the number of colonies, whereas the glycerine plate showeda diminution. The vaseline plate, moreover, after four days, became covered with colonies of a green mould (penicillium glaucum), and was useless for photographic purposes.

At the end of the second week of this experiment it was found impossible to continue it as regarded the vaseline and lanoline emulsions. These had become, in their separate sterilised stoppered bottles, both covered with a luxuriant crop of the above green mould. No such growth appeared in the bottle containing the glycerine emulsion. On the contrary, plates established from it, after two and three weeks storage, showed further diminution in the number of colonies; and at the end of the fourth week the comparison plate was altogether free from extraneous organisms.

Thus, Experiment No. IV. proved, as did Experiment No. I., the superiority of glycerine (dilute) over vaseline and over lanoline in eliminating the extraneous organisms which are commonly present in vaccine material.

In the foregoing experiments it will have been noted that the plates used for comparison were, in nearly every instance, plates established from agar test tubes directly inoculated from the emulsion. The exception to this rule was Experiment I., in which the plates used for comparison were established from agar tubes inoculated, not directly from the emulsions, but from the primary agar tubes in which loopfuls of emulsion had been, in the first instance, distributed. In that experiment, the sterile plate obtained at the end of the fourth week of storage of vaccine material *in glycerine* was the only plate of the series established

directly from the original emulsion which has been photographed. It remains to be stated in this connexion that, in the majority of the instances, the results were "controlled" by duplicate plates established at the same time; and, furthermore, that material which in plate culture showed no colonies was always tested again two or three times in similar fashion.

The Bacteriology of Vaccine derived from Vaccinated Calves.

As has been repeatedly shown, calf lymph ordinarily contains a large number of organisms which are in no way concerned with its specific action. Also it has been shown that lymph, if carelessly collected, may contain many or any of the numerous saprophytes common to dust, dirt, &c., as well as, perhaps, certain pathogenic microbes. Finally, it has been shown that, by the use of the glycerine method, these bacteria may be greatly reduced in numbers if not altogether eliminated.

In the above experiments, and in a very large number of other examinations of samples of calf lymph, the following organisms were found. They are arranged in the order of their prevalence and predominance.

1. Staphylococcus cereus flavus } (Passet).
   "　　" albus }
2. Large yeast, orange coloured.
   Small yeast, light brown colour.
   Small yeast, pale salmon colour, and very slow growing.
3. Staphylococcus pyogenes albus (Rosenbach).
4. Staphylococcus pyogenes aureus (Rosenbach).
5. Staphylococcus pyogenes citreus (Passet).
6. Bacillus mesentericus vulgatus.
7. Bacillus subtilis.
8. Moulds, *penicillia, mucors, aspergilli:* Sarcinæ, *lutea, aurantiaca.*

In all series of experiments here dealt with, groups 1 and 2 were always present. The slow growing yeast was not, however, generally visible as a distinct colony till the seventh or eighth day.

Staphylococcus pyogenes albus was frequently present in lymph, but generally in small numbers.

Staphylococcus aureus was rather less frequently observed, and S. citreus was only occasionally found.

Bacillus mesentericus may be regarded as accidental.

Bacillus subtilis rarely occurred if precautions were taken; its presence seeming to depend entirely on the care exercised in collecting the lymph. The same is true of group 8.

It must be stated, however, that all the samples of calf lymph examined were derived from the same station, namely, from the Animal Vaccine Establishment, Lamb's Conduit Street. Here calf-to-calf vaccination is continuously practised; so that the adventitious saprophytes found in the lymph at one and another time are apt to be similar in kind, the extraneous organisms originally present having been, so to speak, cultivated *pari passu* with the vaccine virus itself. Very possibly, therefore, a strain of lymph from another station might present a "flora" differing in kind and in amount, as indeed has been found to be the case with certain foreign lymphs. In this connexion it may be noted that lymph taken directly from calves vaccinated with vaccine material rendered free from extraneous organisms, as for instance with glycerinated lymph a month after glycerination, often presents remarkably few

colonies of such organisms. In one such sample only four colonies appeared on a plate culture of the lymph; one of staphylococcus cereus albus and three of the light brown yeast.

Experiments on the action of Glycerine upon the Life and Growth of Yeasts.

As a sequel to former experiments with glycerine upon the vitality of various bacteria, recorded in a paper read before the British Association at the Liverpool Meeting, in 1896, the action on yeasts of differing per-centages of glycerine in a culture medium was tested on several different samples. Test tubes containing equal quantities of peptone beef broth, but mixed with amounts of glycerine ranging from 20 to 30, 40, and 50 per cent., were, after sterilisation, inoculated with five different yeasts. Care was, of course, taken that the amounts of yeast inoculated in the tubes were approximately equal; and, at the same time, tubes of peptone beef broth without glycerine were similarly inoculated with the yeasts to serve as control experiments.

The yeasts used were—

Common pink yeast (Rosa Hefe), not found in vaccine lymph.
Orange coloured yeast, common in vaccine calf lymph.
Dark brown yeast, isolated from garden mould.
Saccharomyces glutinis.
Light brown yeast, isolated from small-pox crusts.

Rosa Hefe resisted the action of 50 per cent. glycerine for four months, and still continued to grow freely.

The orange coloured yeast succumbed to 40 per cent. glycerine in a fortnight, and to 20 per cent. glycerine in four weeks.

The dark brown yeast resisted the action of 40 per cent. glycerine for eight weeks, and 20 per cent. glycerine for sixteen weeks.

Saccharomyces glutinis was still alive after a fortnight in 20 per cent. glycerine, but it failed to grow in peptone beef broth containing higher per-centages of glycerine.

The "small-pox crust" yeast succumbed to 40 per cent. glycerine in a month, and even 20 per cent. glycerine inhibited its growth after eight weeks.

All the control experiments which were carried on simultaneously with each periodical examination of the glycerinated tubes gave positive results.

There is here shown a marked variation in the power of resistance to the action of glycerine possessed by different yeasts. The prolonged resistance of some kinds is of interest; but it is specially noteworthy that this power of resistance to the action of glycerine is not characteristic of those yeasts which have, on one or another occasion, been isolated from vaccine lymph.

PLATE-CULTURE TEST OF VACCINE LYMPH

PRESERVED IN ONE AND ANOTHER WAY.

PLATE I.

FIG. I.

Photograph of *second* agar plate, incubated for seven days subsequent to inoculation with GLYCERINE vaccine emulsion which had *not* been stored after preparation.

Numerous micro-organisms, chiefly staphylococci, are seen to have developed.

FIG. 2.

Photograph of *first* agar plate, incubated for seven days subsequent to inoculation with GLYCERINE vaccine emulsion which had been stored for *four weeks* after preparation.

No growth whatever has occurred.

PLATE I.

FIG 1.

FIG. 2.

PLATE II.

FIG. 3.

FIG. 4.

PLATE-CULTURE TEST OF VACCINE LYMPH

PRESERVED IN ONE AND ANOTHER WAY.

PLATE II.

FIG. 3.

Photograph of *second* agar plate, incubated for seven days subsequent to inoculation with VASELINE vaccine emulsion which had *not* been stored after preparation.

The plate shows a copious growth of extraneous microbes.

FIG. 4.

Photograph of *second* agar plate, incubated for seven days subsequent to inoculation with VASELINE vaccine emulsion which had been stored for *six weeks* after preparation.

The plate is seen to be crowded with colonies of extraneous microbes.

PLATE-CULTURE TEST OF VACCINE LYMPH
PRESERVED IN ONE AND ANOTHER WAY.

PLATE III.

FIG. 5.

Photograph of *second* agar plate, incubated for seven days subsequent to inoculation with LANOLINE vaccine emulsion which had *not* been stored after preparation.

The plate shows a copious growth of extraneous microbes.

FIG. 6.

Photograph of *second* agar plate, incubated for seven days subsequent to inoculation with LANOLINE vaccine emulsion which had been stored for *six weeks* after preparation.

The plate is seen to be crowded with colonies of extraneous microbes.

PLATE III.

Fig. 5.

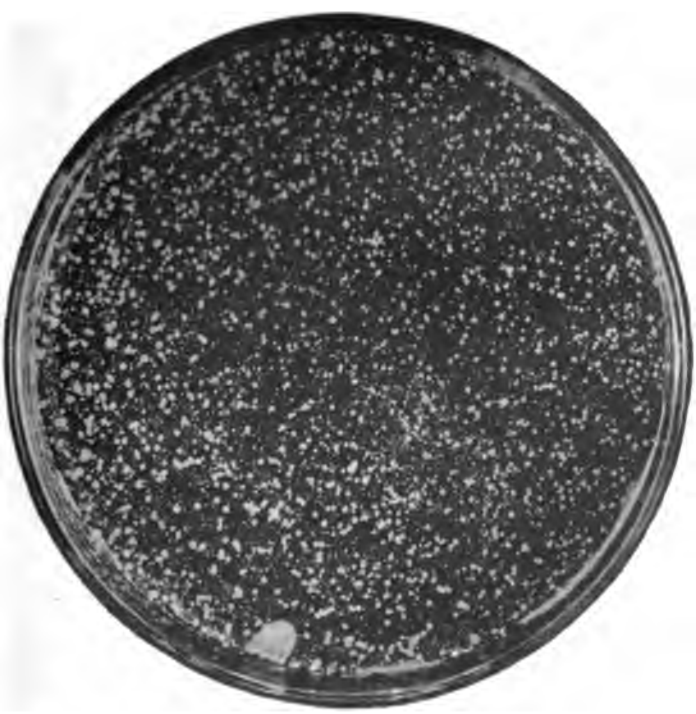

Fig. 6.

PLATE IV.

FIG. 7.

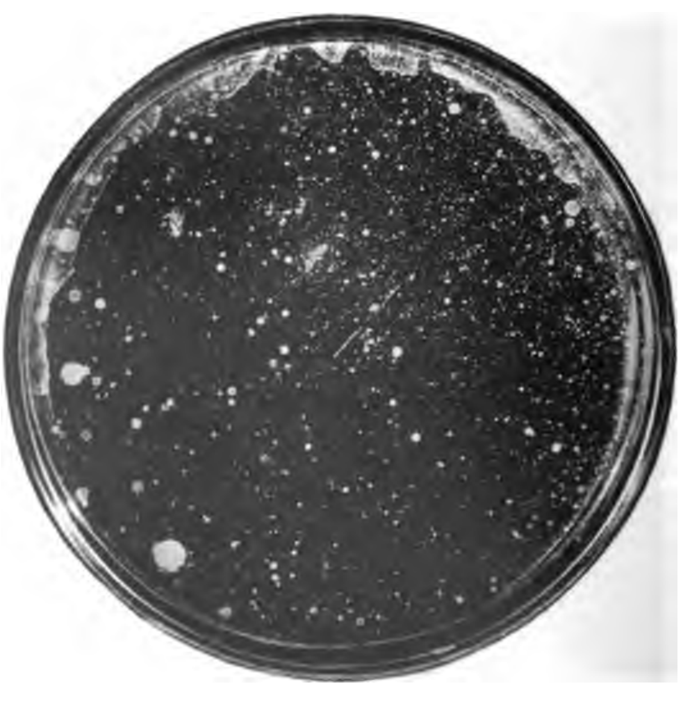

FIG. 8.

PLATE-CULTURE TEST OF VACCINE LYMPH
PRESERVED IN ONE AND ANOTHER WAY.

PLATE IV.

FIG. 7.

Photograph of agar plate, incubated for seven days subsequent to inoculation with *one loopful* of rubbed-up vaccine material *prior to its admixture* with glycerine.

FIG. 8.

Photograph of agar plate, incubated for seven days subsequent to inoculation with *five loopfuls* of the same material *immediately after* glycerination.

The number of colonies on these two plates will be observed to correspond closely.

PLATE-CULTURE TEST OF VACCINE LYMPH

PRESERVED IN ONE AND ANOTHER WAY.

PLATE V.

FIG. 9.

Photograph of agar plate, incubated for seven days subsequent to inoculation with *five loopfuls* of the stock glycerinated emulsion *one week* after preparation.

The number of colonies is somewhat diminished.

FIG. 10.

Photograph of similar agar plate, inoculated *a fortnight* after glycerination.

A further decrease in the number of colonies is now conspicuous.

PLATE V.

Fig. 9.

Fig. 10.

PLATE VI.

FIG. 11.

FIG. 12.

PLATE-CULTURE TEST OF VACCINE LYMPH
PRESERVED IN ONE AND ANOTHER WAY.

PLATE VI.

FIG. 11.

Photograph of agar plate, incubated for seven days subsequent to inoculation with *five loopfuls* of the stock glycerinated emulsion *three weeks* after preparation.

The decrease in the number of colonies is still more marked than in the former plates.

FIG. 12.

Photograph of similar agar plate, inoculated *four weeks* after glycerination.

No growth whatever has occurred.

VESICLES PRODUCED ON INFANT VACCINATED WITH GLYCERINATED LYMPH.

PLATE VII.

Fig. 13.

Photograph of child, taken on the eighth day of vaccination, with glycerinated vaccine lymph, which, as shown in Fig. 12, was found, when tested by the method of plate cultivation, to be free from extraneous micro-organisms.

PLATE VII.

FIG. 13.

PLATE VIII.

FIG. 14.

VESICLES PRODUCED ON INFANT VACCINATED WITH GLYCERINATED LYMPH.

PLATE VIII.

FIG. 14.

Photograph of child, taken on the tenth day of vaccination, with glycerinated vaccine lymph, which, after storage for four weeks, was found, when tested by the method of plate cultivation, to be free from extraneous micro-organisms.

This child formed one of a series of 36 cases, all vaccinated (in five insertions each) by Dr. Cory on the same day and with the same sample of glycerinated lymph. In this series Dr. Cory obtained 100 per cent. of insertion success.

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